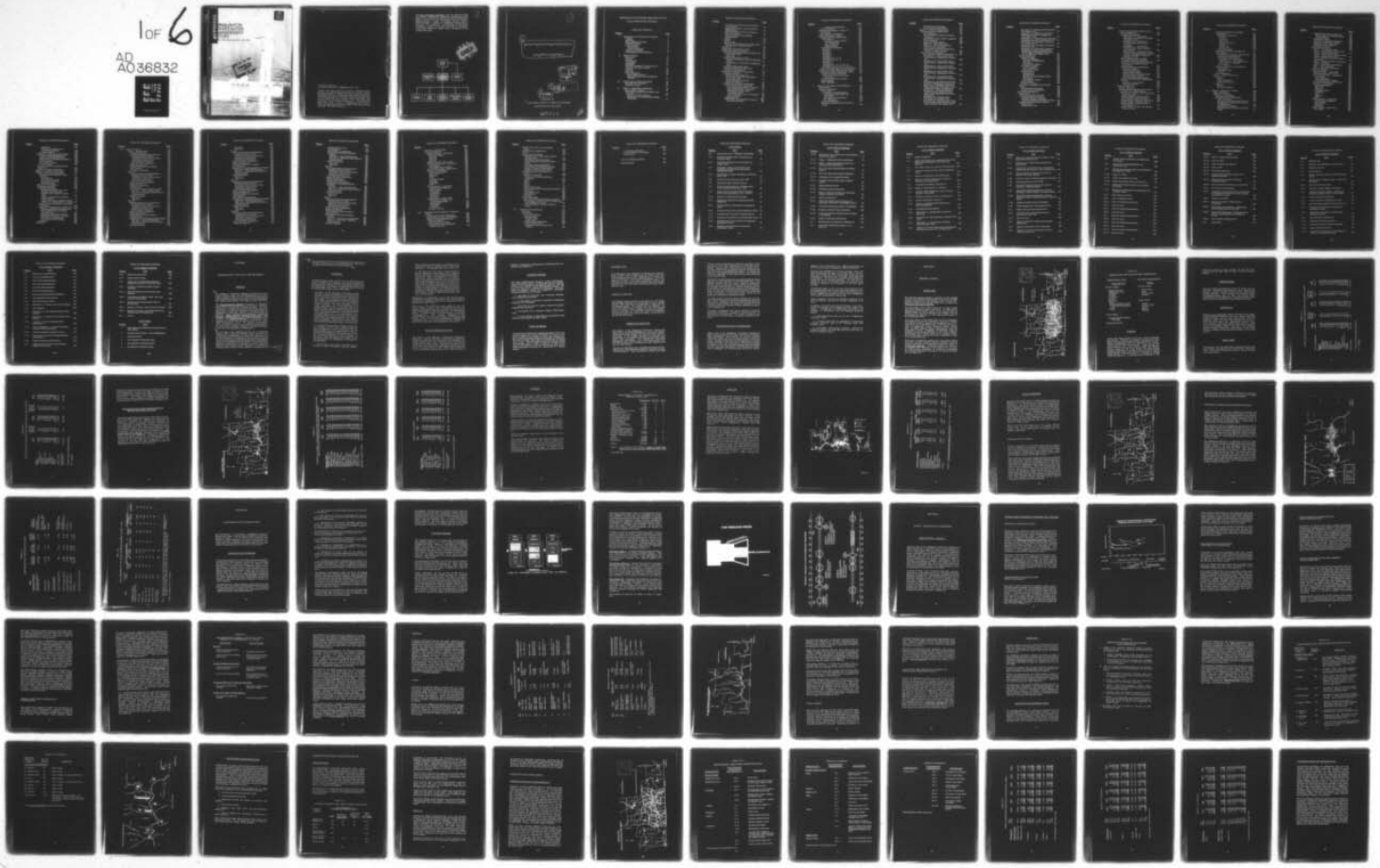
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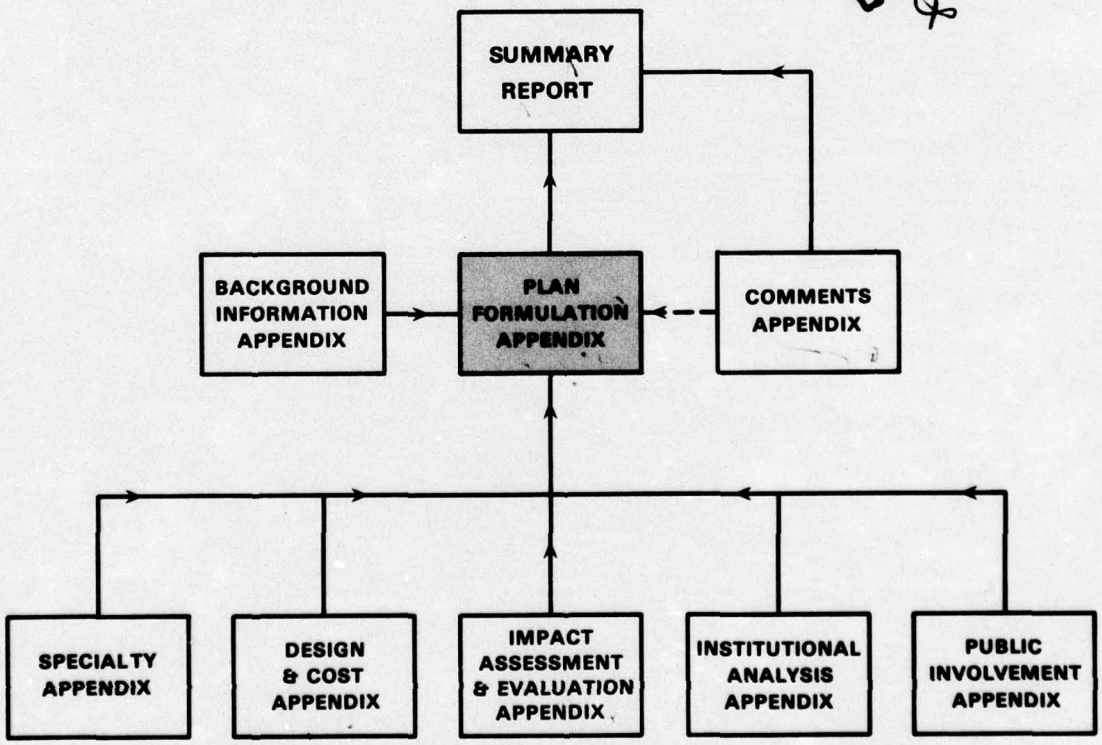

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"The Raft of Summer"
Courtesy of Paul Smith, Binghamton, New York

Someone once said a picture is worth a thousand words, and the cover photograph summarizes the study in a simple but graphic manner. Today, the modern Huck Finn can enjoy many scenic and recreational opportunities associated with a Susquehanna River relatively free of pollutants. But tomorrow when the boy is grown, will the river still offer clean water for his children's enjoyment? This study suggests some ways to keep the Susquehanna clean and to ensure that future generations in Broome and Tioga Counties can enjoy "The Raft of Summer."

The Plan Formulation Appendix is the key document of the nine volume Binghamton Wastewater Management Study Report. It summarizes all appendices while describing pertinent decisions and their interactions with the iterative planning process. Design of component systems, assessment of impacts, analysis of institutional arrangements, evaluation of alternatives, and discussion of the public involvement program is included along with the comparison of the final "Plans for Choice" and a discussion of the recommended plan.

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BINGHAMTON WASTEWATER MANAGEMENT STUDY

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CHAPTER I

INTRODUCTION TO THE STUDY AND THE REPORT

PREFACE

The Binghamton Wastewater Management Study was a cooperative Federal, State, and local planning effort to develop viable alternative plans for the protection and enhancement of water quality and associated resources of the Susquehanna River Basin within Broome and Tioga Counties, New York.

The Plan Formulation Appendix documents all significant events and decisions involved in the formulation, evaluation, and selection of wastewater management plans. As such, it provides a sequential summary of progress throughout the Study. Other supporting appendices, presenting detailed information on particular elements of the Study include the following: Impact Assessment and Evaluation, Institutional Analysis, Design and Cost, and Public Involvement. Also included is the Specialty Appendix which presents detailed analyses of investigations that either overlapped the other appendices or were a self-contained portion of the Study. These investigations were: the Outlying Communities, river recreation, nonstructural measures, land application, non-point source pollution, industrial wastewater management, and an archaeological reconnaissance.

The first step in the planning process was to determine Federal, State, and local problems, issues, and objectives of wastewater management. To meet these objectives, alternative plans were formulated through an iterative process of: systems design, an assessment of all pertinent impacts, and an evaluation of the plans' effectiveness in fulfilling the objectives. Final "Plans for Choice" were compared by displaying all significant environmental, economic, and social impacts. Also contained in this Appendix is a summary of the institutional analysis which proposed arrangements for

next page

cont → implementation of each of the final plans and a summary of the public interaction in the planning process. The recommended plan is described in the last chapter.

AUTHORITY

Section 235 of the Flood Control Act of 1970 directs the Corps of Engineers to investigate and study the availability, quality, and use of water and to develop comprehensive plans for construction, operation, and maintenance of facilities in the Susquehanna River Basin. Applicable parts of the text for Section 235 of Public Law 92-611 follow.

> Sec. 235. (a) The Secretary of the Army, acting through the Chief of Engineers, is authorized and directed, as part of the comprehensive study of the water and related resources of the Susquehanna River Basin, to investigate and study, in cooperation with the Administrator of the Environmental Protection Agency and other interested departments, agencies, and instrumentalities of the Federal Government and of the governments of States and their political subdivisions, the availability, quality, and use of waters within the basin with a view toward assisting in the preparation of a comprehensive plan for the development, conservation, and use of such waters. The Environmental Protection Agency shall have the responsibility in carrying out this section for those aspects of the development, conservation, and use of such waters which are essentially within its jurisdiction.
>
> b. In connection with such investigations and study, the Secretary of the Army, acting through the Chief of Engineers, and in cooperation with the Environmental Protection Agency and all other interested Federal agencies, shall make such studies and develop such plans as deemed necessary for the construction, operation, and maintenance of facilities in selected regions of the basin, including augmentation of streamflows by releases of stored waters.
>
> c. Such facilities may include, but shall not be limited to, water conveyance systems; regional

waste treatment, interceptor, and holding facilities; water treatment facilities; and facilities and methods for recharging ground water reservoirs.

d. The Secretary of the Army, acting through the Chief of Engineers, shall submit to the Congress any and all parts of plans prepared pursuant to this section, which are approved by the Susquehanna River Basin Commission as in accordance with its comprehensive plan for the immediate and long-range development and use of the water resources of the basin, including all recommendations of the Environmental Protection Agency with respect to matters under its jurisdiction, and shall include recommendations for authorization and appropriate financial participation and cooperation by the States, political subdivisions thereof, and other local interests.

Acting under this legislation, former New York Congressman Harold W. Robison (27th District) was instrumental in initiating the Binghamton Wastewater Management Study for Broome and Tioga Counties.

Other areas in the Susquehanna River Basin are now subjects of similar studies. In the Corning-Elmira area, the Southern Tier Central Regional Planning and Development Board (STCRPDB) has been designated as the 208 planning agency. In Pennsylvania, the Commonwealth is preparing a Comprehensive Water Quality Management Plan (COWAMP) for the entire state similar to 208-type planning efforts. These three studies (Binghamton, COWAMP, and STCRPDB), then, will provide areawide waste management plans for the majority of the Susquehanna River Basin.

STUDY PURPOSE AND SCOPE

The purpose of the Binghamton Wastewater Management Study was to develop both short and long-range wastewater management plans for the metropolitan area of Broome and Tioga Counties, New York. The plans were formulated to complement the water quality programs of the State of New York, achieve the objectives of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500), and meet the planning requirements of the Water Resources

Council's "Principles and Standards for Planning Water and Related Land Resources."

PLANNING PROCESS

This study considered the economic, social, institutional, and environmental impacts in conjunction with the technical aspects for all wastewater management programs. Through an active and involved citizen participation program, all plans were geared to acceptance by the public. The basic tasks accomplished during the Binghamton Wastewater Management Study were as follows:

a. The nature of wastewater and associated problems were identified and assessed.

b. A wide range of alternative wastewater management strategies were developed.

c. Beneficial and adverse impacts relative to proposed solutions were assessed.

d. Alternatives were evaluated in light of study objectives.

e. A small number of final plans were presented to the State and local officials for their choice.

LEVEL OF DETAIL

The Binghamton Wastewater Management Study made a systematic comparison of major alternatives in terms of technical feasibility; environmental, social, and economic impacts; implementation arrangements; and public acceptability. The level of design detail used in the study was of "survey scope" detail. The investigation developed sufficient design and evaluation detail to allow a choice to be made from a range of alternatives; it did not, however, provide the detailed design data necessary for construction of a specific project.

INTEREST RATE

For preliminary cost estimation, an interest rate of 6% was used. In later, more refined work, the interest rate used in developing costs was that mandated by the Water Resources Council. The rate in effect throughout most of the Study was 5 7/8%. Near Study completion, however, the interest rate for Federal water resources plans was revised upwards to 6 1/8%. All costs for the final four plans reflect this new rate.

PERIOD OF ANALYSIS

The planning period selected for the Study was 1977-2020. Formulating, assessing, and evaluating all plans through the year 2020 assured the consideration of long term environmental effects. For purposes of cost analyses, a 50 year (1977-2027) project economic life was used through most of the Study. To be consistent with EPA guidelines, however, the final four "Plans for Choice" were evaluated on a project life of 20 years (1977-1997), as well as on a project life of 50 years.

PRODUCT OF THE STUDY

The product of the Binghamton Wastewater Management Study was an areawide investigation of wastewater management problems and solutions in Broome and Tioga Counties, New York. In this regard, the product of the Study was comparable to the planning activities accomplished under EPA's "208" programs. The Binghamton Wastewater Management Study fulfills most of the requirements of the EPA 208 program while satisfying the Corps' guidelines for survey scope reports.

The survey scope Study, then, formulated and analyzed cost-effective and environmentally-effective wastewater management alternatives. These alternatives ranged from a plan

to meet current requirements within the immediate future to a plan to achieve the highest levels of wastewater treatment by the year 1985, consistent with the goals of P. L. 92-500. Additionally, the alternatives were designed to the year 2020 with an accompanying schedule of construction priorities and implementation procedures. The Plans for Choice are displayed in this Report as an aid for decisions on an areawide basis.

The Plans for Choice have been presented to State and local officials for their selection of a recommended plan. This adopted areawide plan now forms a basis for applying to EPA for grants in connection with the 201 facilities program for advanced planning (Step 1), detailed design and specifications (Step 2), and construction (Step 3) of individual projects. Some of the advanced planning normally accomplished under the 201 Step 1 activity has already been performed in the development of the survey scope report for the Binghamton Wastewater Management Study.

The adopted plan can also be used to evaluate and, if necessary, amend the current wastewater comprehensive plans for each county. Whichever cource of action the local and State decision-makers choose, the Report is intended as an aid to Broome and Tioga Counties in future planning for wastewater management.

The Corps of Engineers' role in this effort was limited to providing a wastewater management planning service for local and State governments. The Corps of Engineers has no authority for construction of wastewater treatment facilities.

PARTICIPATION AND COORDINATION

Public input to the Binghamton Wastewater Management Study stemmed primarily from three groups: the Interagency Study Management Group (ISMG), the Citizens Advisory Committee (CAC), and the Technical Advisory Committee (TAC). The ISMG was formed to provide guidance and ensure timely completion of the Study by coordinating the activities of Federal, State, and local agencies. Participants included the Southern Tier East Regional Planning Board (STERPB); the New York State Department of Environmental Conservation (NYSDEC); the Environmental Protection Agency,

Region II; the Susquehanna River Basin Commission; and the U.S. Army Corps of Engineers, Baltimore District.

The CAC was established to provide a primary vehicle for public involvement and input to the Study effort. Its purpose was to assist the ISMG during plan formulation and evaluation of alternatives and to identify issues important to the region. The committee consisted of 45 members influential in water resources planning. The CAC was originally set up by the STERPB and later expanded at the request of members and participants at the first public meeting.

To assist the ISMG, a TAC was set up to evaluate the technical engineering details of the study. Staff members from the ISMG agencies, the Broome County Health Department, and the Engineering Department for the City of Binghamton made up the representation of this group.

These committees reviewed all pertinent segments of the work and reports, and provided valuable assistance to the study.

In addition to the public involvement program, much information was obtained from ongoing and prior studies and reports. Coordination was established to provide for an exchange of information with the following concurrent studies:

a. Inflow/Infiltration Study for the City of Binghamton (Shumaker, 1974).

b. A study to determine the feasibility of constructing a sewage treatment plant in the Chenango Valley area (Martin, 1975).

c. Riverbanks Improvement Program conducted by STERPB to enhance the land adjacent to the rivers as a regional recreation resource.

CHAPTER II

REGIONAL PROFILE

STUDY AREA

The following sections furnish a summary of the existing physical and economic characteristics of Broome and Tioga Counties (referred to as the Bicounty Area). A more complete description of the regional profile may be found in the Background Information Appendix.

The Susquehanna River Basin drains all of Tioga County and most of Broome County, New York. A small portion (approximately 90 square miles) of the eastern sector of Broome County lies in the Delaware River Basin, and was not included as authority for this Study limits activity to the Susquehanna Basin.

The major effort of this Study focused on the Binghamton metropolitan area as this urbanized region has a significant impact on water quality in the Susquehanna River. Referred to as the Urban Study Area, it includes the communities of Binghamton, Owego, Endicott, Vestal, Johnson City, and other smaller nearby municipalities along the Susquehanna River. Expanding developments along the Nanticoke Creek Valley upstream to the Town of Maine, the Chenango River Valley upstream to Chenango Bridge, and the Five Mile Point area are also considered as part of the Urban Study Area.

Wastewater management problems for communities outside this urban area and a general outline of possible treatment options is presented in the Outlying Communities Chapter of the Specialty Appendix. Urban communities for which detailed plans were developed (Urban Study Area) and those for which general approaches to wastewater management were outlined (Outlying Communities) are shown in Figure II-1 and Table II-1.

BICOUNTY STUDY AREA

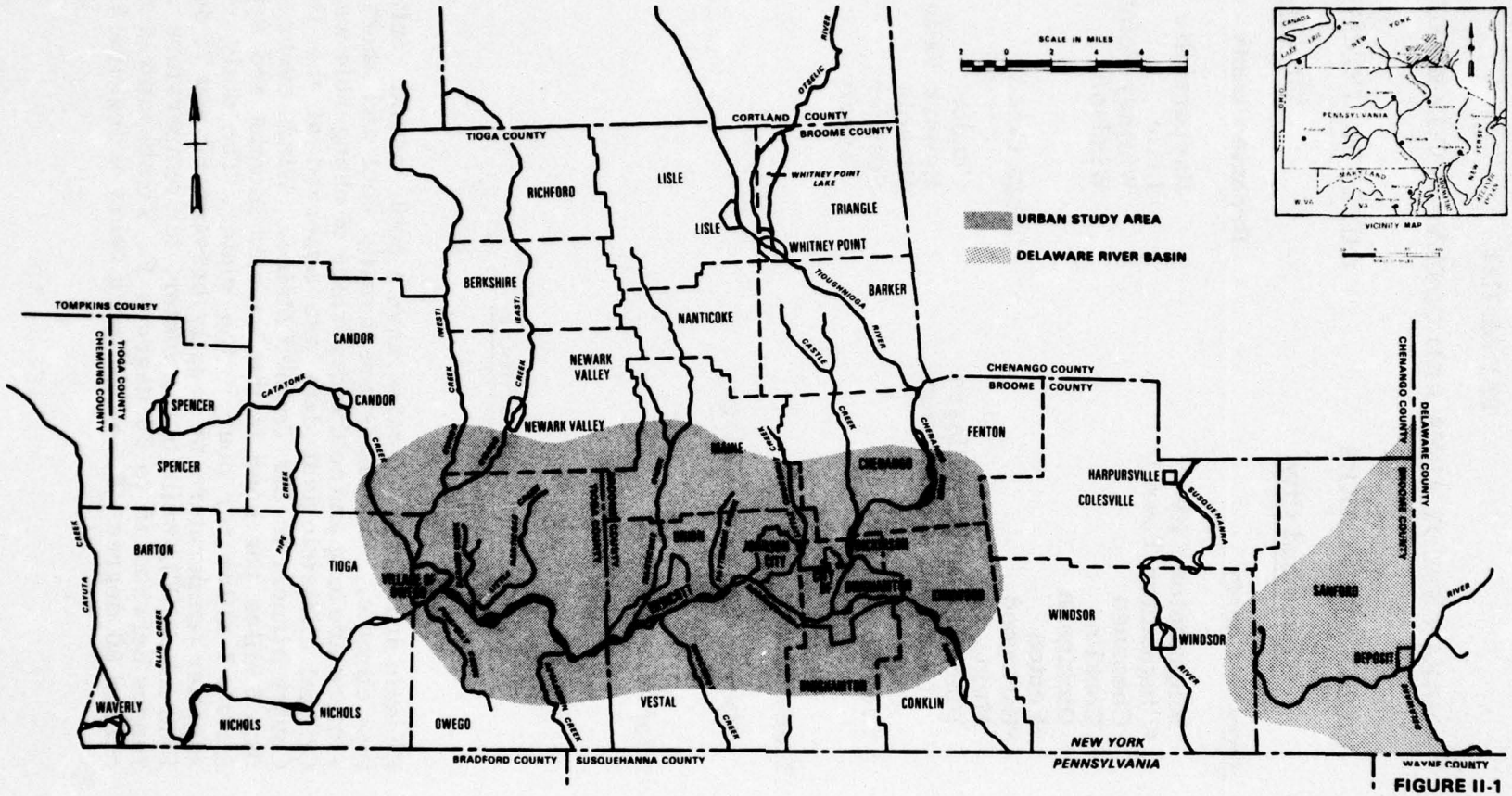


FIGURE II-1

TABLE II-1

URBAN STUDY AREA AND OUTLYING COMMUNITIES

URBAN STUDY AREA	OUTLYING COMMUNITIES
Towns and City	Villages
Broome County	Broome County
Binghamton City	Harpursville
*Binghamton Town	Lisle
Chenango	Whitney Point
Conklin	Windsor
Dickinson	
*Fenton	
*Kirkwood	Tioga County
Maine	
Union (Including Villages of Endicott and Johnson City)	Candor
	Newark Valley
	Nichols
*Vestal	Spencer
	Waverly
Tioga County	
*Owego (includes Village of Owego)	

*Portions of Town

CLIMATE

Broome and Tioga Counties have a cool, humid continental type climate. Summers are usually cool and short while winters are long and cold with periods of changeable weather. Official climatological data are observed at the Broome County Airport in the Town of Maine. Winds average less than 5 miles per hour in the warmer months and approximately 7 miles per hour in the winter. The daily average summer temperature is usually between 62 and 75 degrees Fahrenheit (F), while in the winter, the temperature usually ranges between 15 to 36 degrees F. Temperatures seldom exceed 90 degrees F, or go much below 0 degrees F. The

freeze-free period averages between 150 and 160 days, usually from the first week in May to the last week in October.

PRECIPITATION

The total annual precipitation of about 37 inches is fairly uniformly distributed throughout the year, although the greatest average monthly rainfall occurs during April through September. In an average year, 162 days receive precipitation greater than 0.1 inch. The average annual snowfall in the City of Binghamton is approximately 50 inches with much more snowfall occurring at higher elevations.

TOPOGRAPHY

Situated in the Appalachian Plateau Province of the Appalachian Highlands of Southern New York, Broome and Tioga Counties occupy a total of 1,238 square miles. Hills are gentle and rolling with elevations ranging from 750 feet to 2,000 feet above sea level. Approximately thirteen percent of Broome County has gentle slopes of 0-5% , sixty percent has moderate slopes (5-15%) and twenty-seven percent has steep slopes (greater than 15%). The southwest portion of Tioga County has predominantly 9-14% slopes while the northeast is characterized by slopes of 6-15% and greater.

POPULATION

The Bicounty Area has experienced moderate growth in the last 20 years, increasing from 215,000 in 1950, to 268,000 in 1970. Table II-2 and II-3 present census data for Broome and Tioga Counties.

TABLE II-2

POPULATION STATISTICS FOR COMMUNITIES IN BROOME COUNTY

	1950	Growth Rate (%) 50-60	1960	Growth Rate (%) 60-70	1970
City of Binghamton	80,674	-5.9	75,941	-15.6	64,123
Towns [1]					
Barker	1,456	15.6	1,683	20.7	2,032
Binghamton	2,073	67.6	3,475	39.4	4,844
Chenango	5,747	71.5	9,858	24.4	12,267
Colesville	3,084	22.3	3,773	17.1	4,420
Dickinson	5,450	20.9	6,591	-13.7	5,687
Fenton	4,168	42.0	5,920	13.5	6,719
Kirkwood	2,997	55.2	4,651	22.3	5,687
Lisle	1,534	3.4	1,587	20.8	1,917
Maine	2,315	69.8	3,931	48.6	5,842
Nanticoke	627	26.6	794	28.5	1,020
Sanford	2,416	3.0	2,489	1.6	2,528
Triangle	1,733	16.5	2,019	13.2	2,285
Union	55,676	15.7	64,423	0.1	64,490
Endicott (V)	20,050	-6.4	18,775	-11.8	16,556
Johnson City (V)	19,249	-0.7	19,118	-5.7	18,025
Vestal	8,902	88.8	16,806	60.1	26,909
Windsor	2,974	47.0	4,373	29.1	5,646
Total County	184,698	15.1	212,661	4.3	221,815

[1] Towns include village population

(V) = Village

TABLE II-3

POPULATION STATISTICS FOR COMMUNITIES IN TIOGA COUNTY

	1950	Growth Rate (%) 50-60	1960	Growth Rate (%) 60-70	1970
Towns [1]					
Barton	8,017	4.3	8,365	1.9	8,526
Waverly (V)	6,037	-1.4	5,950	-11.6	5,261
Berkshire	912	4.5	953	15.2	1,098
Candor	2,879	21.2	3,488	20.1	4,190
Newark Valley	2,384	20.8	2,880	15.4	3,323
Nichols	1,685	18.6	1,998	13.7	2,271
Owego	9,941	48.0	14,710	38.2	20,336
Owego (V)	5,350	1.3	5,417	-4.9	5,152
Richford	787	2.2	804	13.9	916
Spencer	1,561	14.7	1,790	24.7	2,232
Tioga	2,000	40.7	2,814	28.7	3,621
Total County	30,166	25.3	37,802	23.0	46,513
Total Bicounty Study Area	214,864	16.6	250,463	7.1	268,328

[1] Towns include village population

(V) = Village

Population trends within the urban areas indicate increasing urbanization adjacent to older and larger communities. The City of Binghamton, Johnson City, Endicott, and the Village of Owego have lost population since 1950, while many of the small municipalities within the Binghamton Metropolitan Area have experienced significant growth. Population concentrations in the Bicounty Area are shown in Figure II-2.

MUNICIPAL POPULATION PROJECTIONS FOR BROOME AND TIOGA COUNTIES

A number of population projections have been made by local, State, and Federal agencies for Broome and Tioga Counties. Projections developed by OBERS (U. S. Department of Commerce, Bureau of Economic Research Analysis and U. S. Department of Agriculture, Economic Research Service), OPS (New York State Office of Planning Services), and STERPB (Southern Tier East Regional Planning Board) were utilized in obtaining Bicounty Area projections. The development of these projections is described in the Background Information Appendix. Estimates of future population levels used for the Binghamton Wastewater Management Study are presented in Table II-4. The 1980 and 1990 projections paralleled the projections derived by STERPB. Projections for the year 2000 were comparable to the OPS projections. Forecasts for 2010 and 2020 were based on OBERS growth rates for the Bicounty Area.

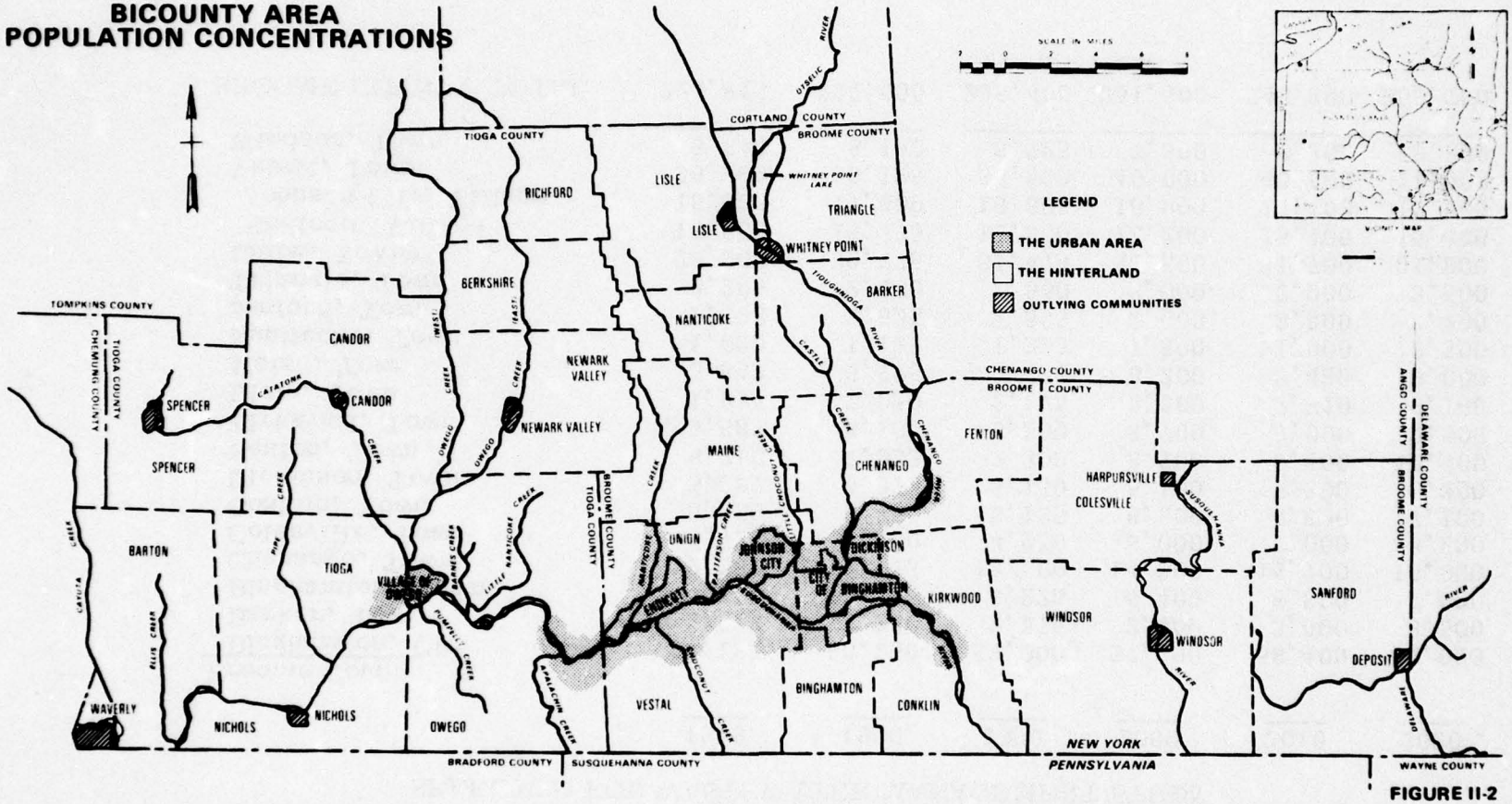

BICOUNTY AREA
POPULATION CONCENTRATIONS
SCALE IN MILES
LEGEND
THE URBAN AREA
THE HINTERLAND
OUTLYING COMMUNITIES
CORTLAND COUNTY
BROOME COUNTY
TIOGA COUNTY
TOMPKINS COUNTY
CHENANGO COUNTY
BROOME COUNTY
DELAWARE COUNTY
BROOME COUNTY
RICHFORD
LISLE
TRIANGLE
WHITNEY POINT
BERKSHIRE
NANTICOKE
BARKER
CANDOR
NEWARK VALLEY
MAINE
CHENANGO
FENTON
HARPURSVILLE
COLESVILLE
SPENCER
BARTON
TIOGA
UNION
JOHNSON CITY
ENDICOTT
BINGHAMTON
KIRKWOOD
WINDSOR
SANFORD
DEPOSIT
VESTAL
CONKLIN
OWEGO
NICHOLS
WAVERLY
NEW YORK
PENNSYLVANIA
BRADFORD COUNTY
SUSQUEHANNA COUNTY
WAYNE COUNTY

FIGURE II-2

TABLE II-4

MUNICIPAL, COUNTY, AND BICOUNTY AREA POPULATION PROJECTIONS
SELECTED FOR WASTEWATER MANAGEMENT STUDY

	1970	1980	1990	2000	2010	2020
Broome County						
Binghamton, City	64,123	60,250	57,900	57,900	58,400	60,000
Barker, Town	2,032	2,150	2,275	2,400	3,000	3,500
Binghamton, Town	4,844	5,475	6,225	6,400	6,600	7,000
Chenango, Town	12,267	13,075	13,900	14,300	14,700	15,000
Colesville, Town	4,420	4,700	4,950	6,000	7,000	8,200
Conklin, Town	5,399	5,750	6,125	6,500	6,800	7,100
Dickinson, Town	5,687	5,375	5,150	5,100	5,200	5,300
Fenton, Town	6,719	7,025	7,300	8,700	9,400	10,200
Kirkwood, Town	5,687	6,100	6,500	6,700	7,000	7,300
Lisle, Town	1,917	2,050	2,175	2,300	2,710	3,100
Maine, Town	5,842	6,775	7,875	8,200	8,480	9,000
Nanticoke, Town	1,020	1,125	1,225	1,500	1,900	2,300
Sanford, Town	2,528	2,525	2,525	2,600	2,800	3,200
Triangle, Town	2,285	2,400	2,500	2,000	2,900	3,500
Union, Town*	29,909	30,775	31,475	31,500	31,700	31,800
Endicott, Village	16,556	15,775	15,200	15,200	15,400	15,600
Johnson City, Village	18,025	17,400	16,875	16,900	17,100	17,300
Vestal, Town	26,909	32,125	38,500	40,000	40,500	41,000
Windsor, Town	5,646	6,150	6,725	7,300	8,300	9,300
BROOME COUNTY TOTAL	221,815	227,000	235,400	241,500	249,890	259,700

TABLE II-4 (Continued)

	1970	1980	1990	2000	2010	2020
Tioga County						
Barton, Town*	3,265	3,975	4,625	5,900	6,300	6,700
Waverly, Village	5,261	4,575	4,100	4,100	4,100	4,100
Berkshire, Town	1,098	1,400	1,900	2,400	2,700	3,000
Candor, Town	4,190	5,125	6,325	7,100	7,500	8,000
Newark Valley, Town	3,323	3,725	4,200	5,000	5,400	6,000
Nichols, Town	2,271	2,525	2,950	3,500	3,900	4,300
Owego, Town*	15,184	20,500	27,800	29,460	31,500	33,100
Owego, Village	5,152	4,850	4,650	4,600	4,800	5,000
Richford, Town	916	1,075	1,325	1,600	1,900	2,300
Spencer, Town	2,232	2,825	3,625	4,000	4,300	4,000
Tioga, Town	3,621	4,525	5,750	7,100	7,900	8,500
TIOGA COUNTY TOTAL	46,513	55,100	67,250	74,760	80,300	85,000
TOTAL BICOUNTY STUDY AREA	268,328	282,100	302,650	316,200	330,190	344,700

*Town total does not include Village(s)

ECONOMY

The foundation of economic activity in the Bicounty Area is manufacturing, primarily electrical machinery. Other sources of employment include government, wholesale and retail trade, services, forestry, and agriculture.

Trends in employment categories in the two counties have shown an increase in government and service employment and a decrease in agricultural employment. Although factory jobs are decreasing in significance relative to other job opportunities, the factory-related skills still constitute the majority of the jobs. The number of professional and technical workers has increased significantly during the last two decades relative to other areas of the country.

Manufacturing is the dominant industrial category, employing 37 percent and 41 percent of Broome and Tioga workers, respectively, in 1970. A significant trend in the manufacturing sector has been the transition from low skill employment, dominated by the leather industry to high skill employment dominated by the electronics and machinery industry.

Table II-5 presents employment by major categories in the Bicounty Area.

The major natural resources of the region are water, agricultural land, and minerals. The overall availability of water in the two counties may act to attract water intensive industries to the region and away from water deficit areas. However, level land is not plentiful and many potential industrial sites do not have sewerage. In addition, many municipalities do not have zoning ordinances that provide for manufacturing firms.

TABLE II-5

EMPLOYMENT BY MAJOR CATEGORIES IN BICOUNTY AREA, 1970

	Employment	Percent	Rank
Agriculture	1,818	2	8
Mining	61	*	9
Construction	5,496	5	5
Manufacturing	(39,935)	38	1
Furniture, lumber & wood	1,051	-	-
Metal industries	2,920	-	-
Machinery, exc. elect.	6,120	-	-
Electrical machinery	15,521	-	-
Transportation equip.	784	-	-
Other durable goods	4,316	-	-
Food & kindred	933	-	-
Textile products	559	-	-
Printing & publishing	1,539	-	-
Chemicals	433	-	-
Other nondurable goods	5,759	-	-
Transportation, Communication, Public Utilities	4,877	5	6
Wholesale & Retail Trade	17,708	17	3
Finance, Insurance, Real Estate	3,662	4	7
Services	10,805	10	4
Government	19,420	19	2
TOTAL	103,782	100	

Source: U. S. Bureau of the Census, Census of Population, General Social and Economic Characteristics, 1970

*Less than 1%

LAND USE

The major existing land use patterns including residential, agriculture, recreation, and industrial areas for Broome and Tioga Counties are shown in Figure II-3. The approximate square miles and percent of each land use category, as defined by the State of New York in their "Land Use and Natural Resource Inventory" are presented in Table II-6. The predominant land uses are woodlands and active agriculture comprising 58 percent and 22 percent of the Bicounty land area, respectively.

Most of the active agricultural acreage is devoted to crop and pasture lands associated with dairy farming. Sharp declines in active agricultural lands have occurred in the last 20 years as the suburbs have expanded. The major agricultural lands are beyond the urban and suburban fringe of the Triple Cities (Binghamton, Johnson City, and Endicott).

Major portions of anticipated growth are expected to be contained within the presently expanding urban core from Five Mile Point to the Village of Owego, and along the Nanticoke Creek Valley and Chenango River Valley. This growth conforms to the general development plan adopted by Broome and Tioga Counties. As part of the General Plan, prime agricultural areas would be sustained through agricultural districting and local land use controls. Major commercial centers would be concentrated within certain sections of expected growth areas with the urban redevelopment sectors of Binghamton and the Village of Owego being the dominant centers. A system of parks and conservation areas along the Susquehanna and Chenango Rivers is envisioned in the Riverbanks Improvement Program, also a part of the General Plan for the two counties. (Egner & Niederkorn Associates, Vol. 4, 1971).

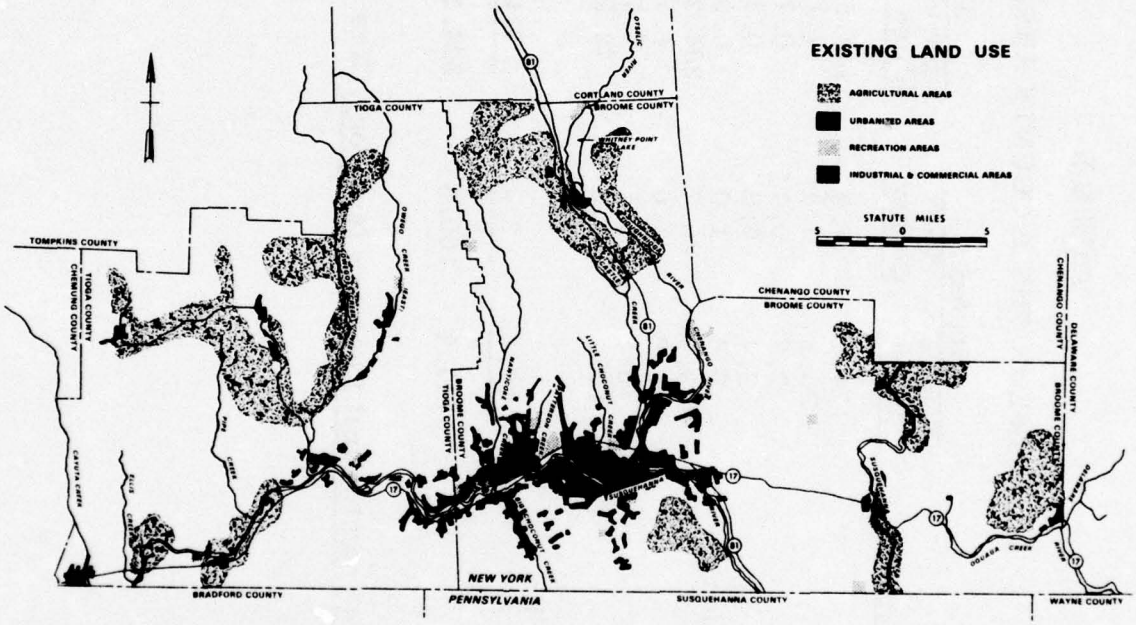

EXISTING LAND USE
AGRICULTURAL AREAS
URBANIZED AREAS
RECREATION AREAS
INDUSTRIAL & COMMERCIAL AREAS
STATUTE MILES
5 0 5
TOMPKINS COUNTY
TIOGA COUNTY
CHEMUNG COUNTY
CORTLAND COUNTY
BROOME COUNTY
CHENANGO COUNTY
BROOME COUNTY
DELAWARE COUNTY
BROOME COUNTY
TIOGA COUNTY
NEW YORK
PENNSYLVANIA
BRADFORD COUNTY
SUSQUEHANNA COUNTY
WAYNE COUNTY

FIGURE II-3

TABLE II-6

LAND USE IN THE BICOUNTY AREA, 1968

Land Use Category	Broome		Tioga		Total Bicounty	
	Square Miles	% of County	Square Miles	% of County	Square Miles	% of Bicounty
Agriculture	127.1	17.8	143.6	27.4	270.7	21.9
Residential	26.8	3.8	7.1	1.4	33.9	2.7
Commercial	2.7	0.4	0.7	0.1	3.4	0.3
Industrial	2.4	0.3	0.2	0.0	2.6	0.2
Outdoor Recreation	6.8	1.0	0.9	0.2	7.7	0.6
Woodlands	433.2	60.7	284.2	54.2	717.4	57.9
Transportation	6.9	1.0	1.7	0.3	8.6	0.7
Wetlands	8.2	1.1	6.7	1.3	14.9	1.2
Non-productive	82.3	11.5	72.2	13.8	154.5	12.5
Other - Water, Extractive, Public, Semi-public	17.3	2.4	7.0	1.3	24.3	2.0
TOTAL	713.7	100.0	524.3	100.0	1,238.0	100.0

Source: Land Use and Natural Resource Inventory, New York State, 1968.

WATER RESOURCES

Except for 90 square miles in eastern Broome County, the Bicounty Area is drained by the Susquehanna River and its tributaries. In eastern Broome County, the Susquehanna River flows north to south until it crosses into Pennsylvania, where it begins to flow in a generally east to west direction, recrossing the New York-Pennsylvania border below Conklin in Broome County. The Tioughnioga River joins the Chenango River at Chenango Forks in Broome County, about 13 miles above the confluence of the Chenango and Susquehanna Rivers in the City of Binghamton. Numerous streams and creeks, including Nanticoke and Owego Creeks flow into the Susquehanna as it proceeds west toward the Village of Waverly in Tioga County.

There is only one large reservoir in the region, Whitney Point Lake, on the Otselic River in northern Broome County. The major waterways for the Bicounty Area are shown in Figure II-4.

WATER SUPPLY SYSTEMS

In 1973, approximately 27 million gallons per day (mgd) of water was supplied to residential, commercial, and industrial users in the Bicounty Area. Of this total, 23 mgd was used in Broome County and 4 mgd in Tioga County. Estimated supplies available from both surface and groundwater are 104 mgd in Broome and 10 mgd in Tioga.

Most municipal and private supply systems rely on groundwater and except for private residences and developments in the upland areas, aquifers are capable of delivering essentially unlimited quantities of high quality water. Two diversions from the Susquehanna River constitute the only major surface water withdrawals. The City of Binghamton withdrew 11 mgd for water supply from the River in 1973. The minimum streamflow of record exceeds 50 mgd at the point of diversion (Rockbottom Dam). The second major surface water withdrawal was about 80 mgd for cooling water used by the New York State Electric and Gas Company at Johnson City. The minimum recorded streamflow at the point of cooling water diversion exceeds 150 mgd.

MAJOR STREAMS

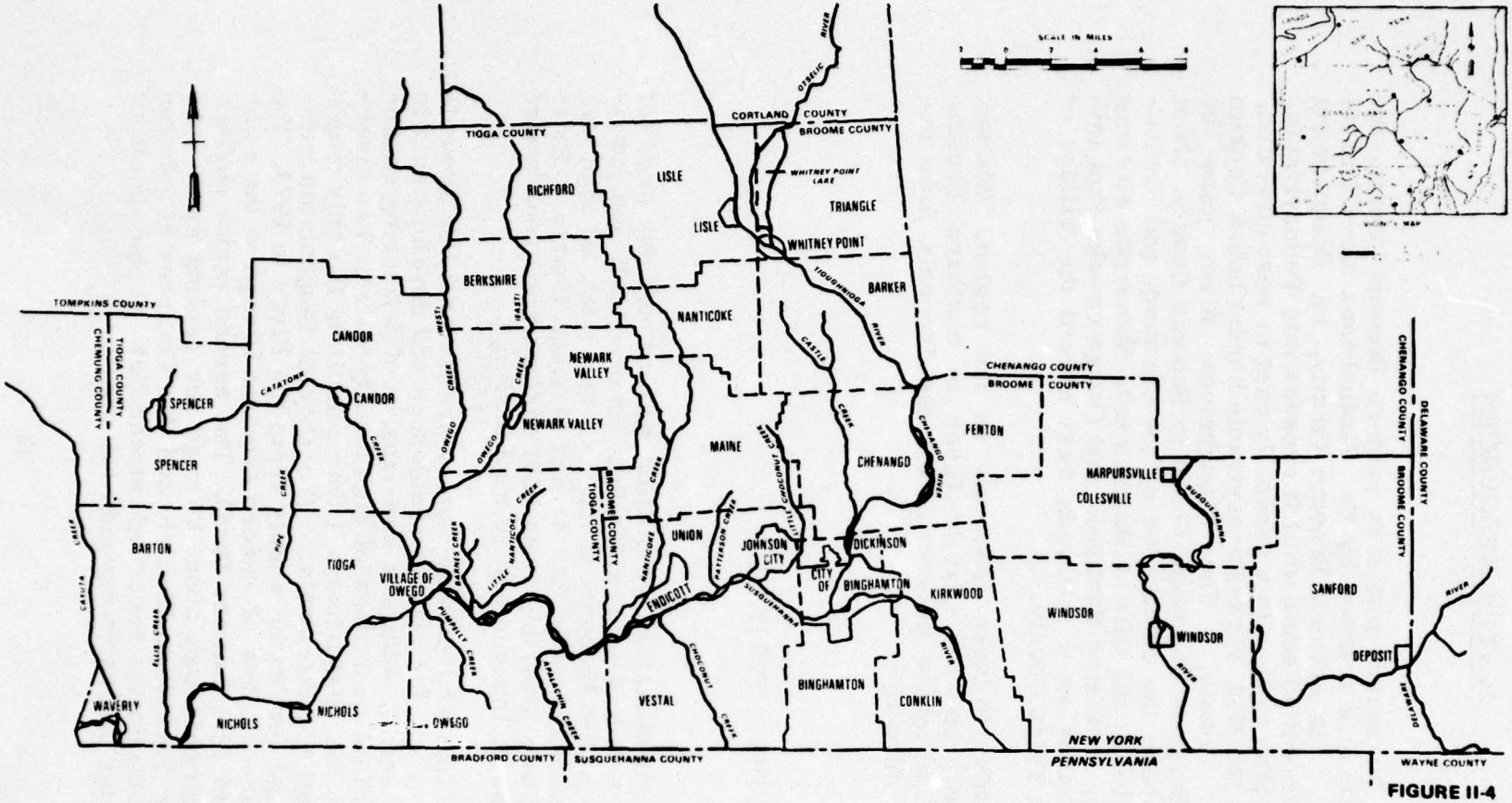


FIGURE II-4

The only water supply problems envisioned by comprehensive studies for the two counties are primarily the expansion of existing facilities and water distribution.

MUNICIPAL WASTEWATER MANAGEMENT SYSTEMS

About 95 percent of the urban population in Broome and Tioga Counties is sewered either with combined or separate sanitary sewers. The remaining population in the Bicounty Area, except for the Village of Waverly and a portion of the Village of Whitney Point (discharging untreated sewage to Cayuta Creek and the Tioughnioga River, respectively) is served mainly by individual septic tanks.

The majority of sewers in Binghamton and Johnson City are of the combined type (stormwater and sanitary wastes in the same pipe). Some are very old and subject to serious infiltration and overflow problems. Significant infiltration problems are also experienced with the Owego Village combined sewer system. The remaining STP's are served by relatively new separate sewer systems and infiltration is not a serious problem.

The Binghamton urban area is presently served by three primary and four secondary sewage treatment plants (STP). Only 6.5 percent of the total wastewater flow is treated by primary systems. The four secondary plants are new, having been put into operation since 1970. The Vestal primary plant is scheduled to be closed in 1976 with flows being diverted to the Endicott STP. The Owego Valley View Imhoff tank will also be shut down when the Owego Village STP is upgraded to secondary treatment. Figure II-5 shows the location of the existing STP's and their service areas. Information concerning sewered population, capacities, and treatment performance of the seven existing plants is presented in Tables II-7 and II-8.

SEWAGE TREATMENT PLANTS AND THEIR SERVICE AREAS

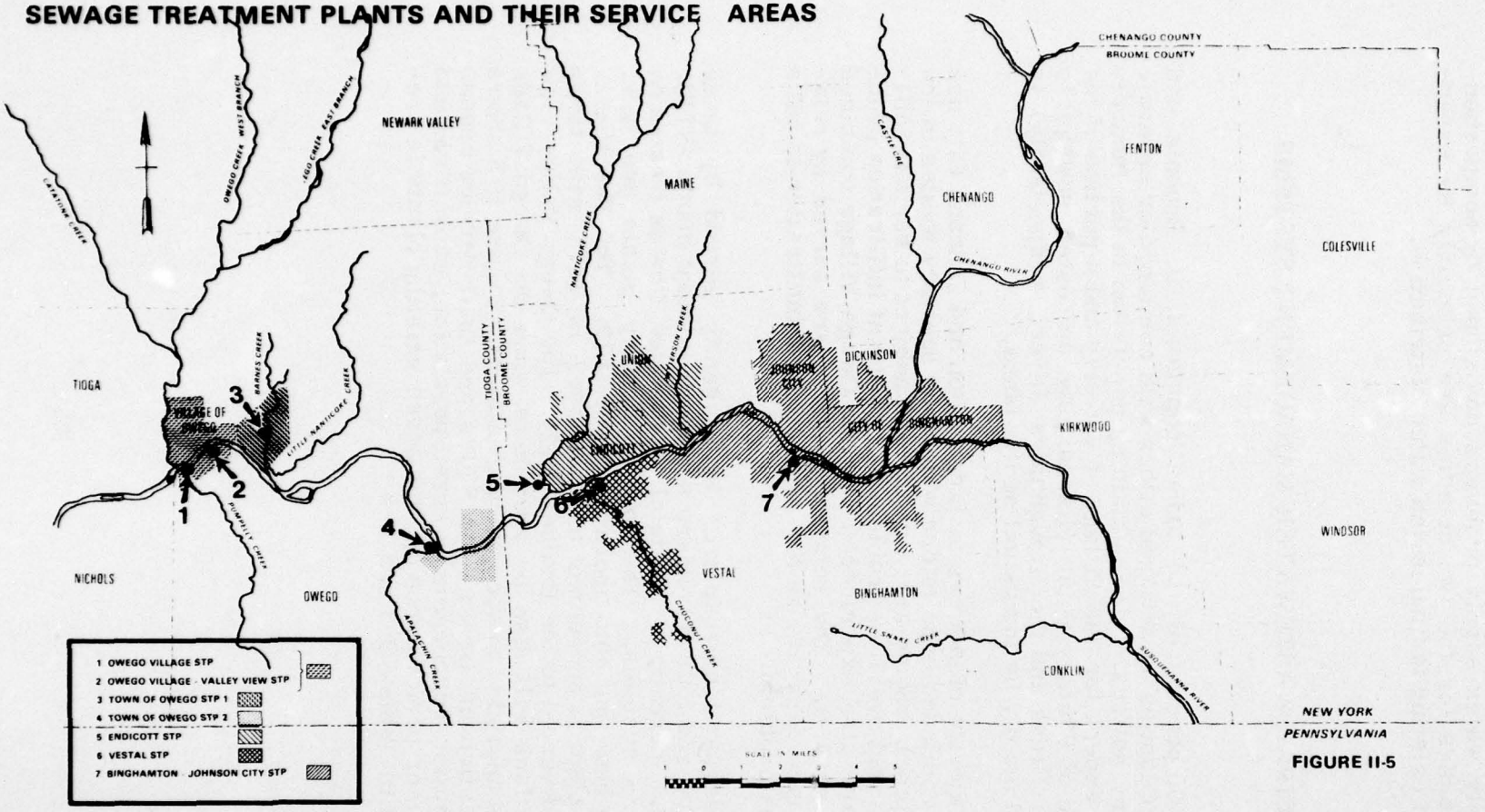


FIGURE II-5

TABLE II-7

EXISTING SEWAGE TREATMENT PLANTS

Name BROOME COUNTY	Sewered Population	Average Flow (mgd)	Design Capacity (mgd)	Type of Treatment
Binghamton-Johnson City Joint STP	102,000	18.30	18.25	Secondary - Activated Sludge
Endicott STP	44,700	4.27	7.67	Secondary - High Rate Trickling Filter
Vestal STP*	7,500	1.00	1.00	Primary
TIOGA COUNTY				
Town of Owego STP #1	600	0.20	0.50	Secondary - Trickling Filter
Town of Owego STP #2	6,500	0.37	2.00	Secondary - Activated Sludge
Owego Village STP	3,600	0.90	0.62	Primary
Owego Valley View*	500	0.05	--	Primary
TOTALS	165,400	25.09	30.04	

*Scheduled to be closed.

TABLE II-8

WASTE CHARACTERISTICS FOR EXISTING WASTEWATER MANAGEMENT SYSTEMS - 1973*

Name	Avg. Flow (mgd)	BIOLOGICAL OXYGEN DEMAND				SUSPENDED SOLIDS			
		INFLUENT (mgd)	EFFLUENT mg/l	EFFLUENT lbs/day	% Removal	INFLUENT (mgd)	EFFLUENT mg/l	EFFLUENT lbs/day	% Removal
Binghamton-Johnson City**Joint Sewage Treatment Plant (STP)	18.30	229	17	2,600	93	454	30	4,600	93
Vestal STP	1.00	240	140	1,200	42	139	42	350	70
Endicott STP	4.27	150	37	1,300	75	167	37	1,300	78
Owego Town STP #1	0.20	156	28	90	82	182	38	130	79
Owego Town STP #2	0.37	145	10	30	93	135	17	50	88
Owego Village STP	0.90	-	78	300	-	-	42	180	-
Owego Village - Valley View STP	0.05	-	200	90	-	-	-	-	-

*Note: Information in the table is obtained from treatment plant operation records. Binghamton-Johnson City Sewage Treatment Plant was converted to a secondary system in May 1973. For Endicott, averages are for the operating data from July 1973 through February 1974.

** Refer to Figure II-5 for location.

CHAPTER III

FRAMEWORK FOR PLAN FORMULATION

The development of wastewater management plans for Broome and Tioga Counties followed guidelines of the Water Resources Council as set forth in the Principles and Standards. These guidelines were used in the planning process to delineate strategies, formulate alternatives, and refine plans. The guidelines of the Water Resources Council and the planning process are described in this chapter.

PRINCIPLES AND STANDARDS

The planning framework for this Study reflects the guidance provided by the Water Resources Council in the "Principles and Standards for Planning Water and Related Land Resources." The Principles and Standards require Federal and Federally assisted water resources projects to be planned toward the achievement of two national objectives: National Economic Development (NED) and Environmental Quality (EQ). All plans are to be measured by a system of accounts: the two objectives, NED and EQ, plus Regional Development (RD) and Social Well-Being (SWB). Using these four public information accounts, the beneficial and adverse impacts of each final plan will be displayed in Chapter VIII of this Appendix.

The NED objective, stated broadly, is achieved by increasing the value of the Nation's output of goods and services and by improving national economic efficiency. The following components achieve this objectivvie, provided there are no significant adverse environmental effects.

a. The amount by which benefits exceed costs should be at a maximum.

b. The goods and services to be produced by a project have value only to the extent that there will be a need and demand for the product.

c. The project, as well as any separable segment or increment selected to accomplish a given purpose, should be more economical than any other available means of accomplishing that specific purpose.

The EQ objective is defined as one which preserves, restores, or improves the environment in which man lives. Generalized components include:

a. Management, protection, enhancement, or creation of areas of natural beauty and human enjoyment such as open and green spaces, water fronts, and beaches.

b. Management, preservation, or enhancement of especially valuable or outstanding archeological, historical, ecological, and geological resources.

c. Enhancement of water, land, and air quality, by control of pollution and harmonizing land use objectives, in terms of economic development with conservation of resources.

d. Avoiding irreversible commitments of resources to future uses by emphasizing a continuous approach (work done in stages rather than all at once) in meeting development objectives. This will minimize the possibility of undesirable and possibly irreversible changes in the natural environment.

The Regional Development (RD) and Social Well-Being (SWB) accounts are primarily issues of local and regional concern. The RD account, for example, would compare the non-Federal costs of each plan, whereas, the NED objective is concerned only with the cost effectiveness of a project regardless of the non-Federal portion. The SWB account is concerned with such factors as disruption of traffic or displacement of homes due to construction, recreation and the aesthetic nature of a project.

Impacts of each are assessed to ensure that all final plans are acceptable and equitable from a local standpoint. The display of the plans according to these accounts aids local decision makers in selecting a final plan.

In summary, the NED objective strives to achieve the most cost-effective solution from a national viewpoint while the EQ objective aims for the maximization of environmental benefits (and the least amount of adverse impacts) measured primarily in non-monetary units. In formulating alternatives, trade-offs naturally occur in trying to maximize these objectives. The final plans presented in this Report tried to reflect a range of acceptable trade-offs between NED and EQ while at the same time satisfying local concerns.

PLANNING PROCESS

The planning process for this study was accomplished in three stages: Stage I - the Plan of Study and preliminary strategy delineation; Stage II - formulation of alternatives; and Stage III - design, evaluation, and refinement of detailed plans. The process was a series of iterations with each stage having four task areas: (1) problem identification, (2) formulation of alternative plans, (3) impact assessment, and (4) evaluation. These tasks were developed in greater detail with each successive iteration of the plan formulation sequence. The relationship of the above planning elements is shown in Figure III-1.

The objectives of the Study were derived from the specific problems and concerns identified for the region and from State and Federal laws and regulations. These objectives provided the direction for plan formulation and, along with the public concerns and issues, provided the means for evaluation of the alternatives.

Impact assessment was the process through which the changes associated with alternative plans were identified and measured to ascertain their full range of economic, social, and environmental effects. The impact assessment task provided the necessary information needed for evaluation of the alternatives. Whereas impact assessment involved identifying and measuring of changes associated with each of the alternatives, evaluation was the process through which both beneficial and adverse values were ascribed to these changes. Evaluation was accomplished by comparing the impacts of alternative plans with the Baseline Condition and with the objectives the Study was directed to achieve.

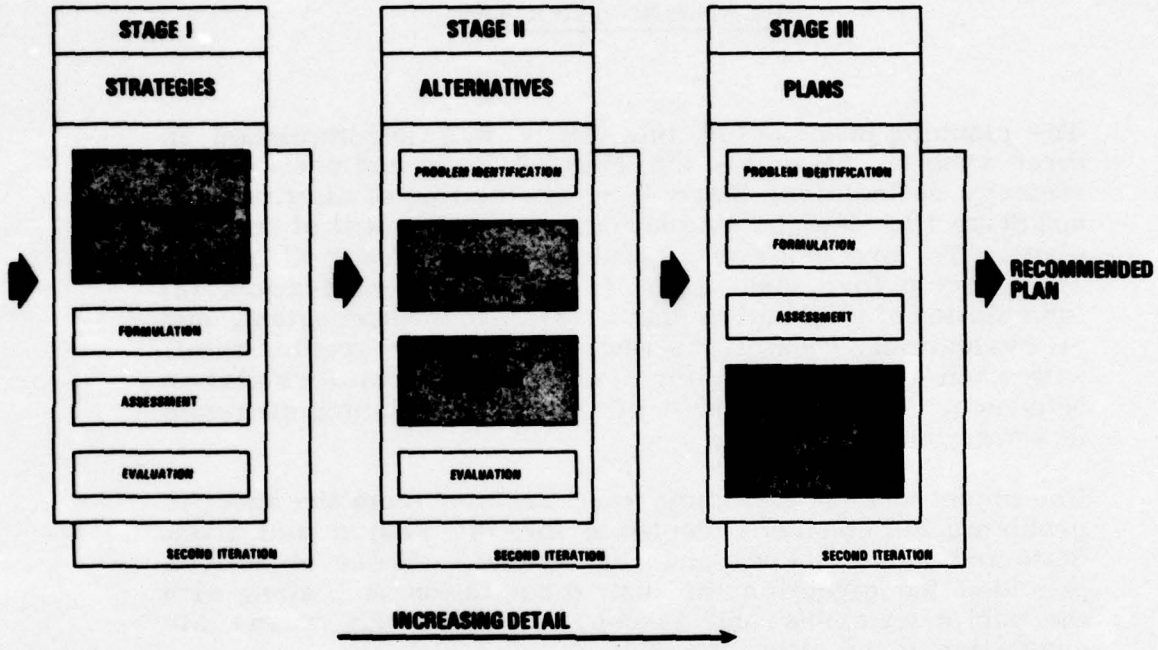


FIGURE III-1. RELATIONSHIP OF PLANNING STAGES, TASKS, AND ITERATIONS

To develop implementable plans for the Binghamton Wastewater Management Study that were acceptable from technical, economic, environmental, and institutional viewpoints, a sequential planning process was established as explained above. Primary emphasis in Stage I was the identification of wastewater management and related problems and objectives (Task 1). Strategies were developed with few restrictions, permitting a wide range of choice. As the level of detail was minimal, impact assessment was necessarily very limited and general in nature.

In Stage II, work was primarily focused on Task 2, formulation and design and Task 3, impact assessment. Detailed costs and impacts were developed to allow selection of the best combinations of treatment components. Complete treatment systems were then refined in Stage III. The main task of this Stage was conducting the evaluation of final plans to accomplish the Study objectives. From these plans, a final plan for implementation was recommended. This sequential formulation process is shown in Figure III-2. For clarification, the following definitions are given:

Strategies (Stage I) - considered mainly technical performance criteria for a wide range of possible systems. They were rather narrow in scope and in their approach to the problems and needs of an area. Costs and impacts were very preliminary, allowing a wide range of systems to be investigated.

Alternatives (Stage II) - detailed cost estimates and impact assessments were made for the wastewater, stormwater, and sludge management components. An alternative was a particular strategy or combination of strategies which had been structured to form an independent treatment system. Some of the unacceptable strategies were dropped from further consideration while other strategies were combined to take advantage of the attractive features of each strategy.

Plans (Stage III) - structural (new facilities or capital improvements) and management components (facilities and institutional management programs) of alternatives were manipulated and combined to form a fully implementable plan. The number of plans was less than the number of alternatives as unacceptable alternatives were discarded through successive screening by impact assessment and evaluation.

The sequence of events for the Study is shown in Figure III-3.

PLAN FORMULATION PROCESS

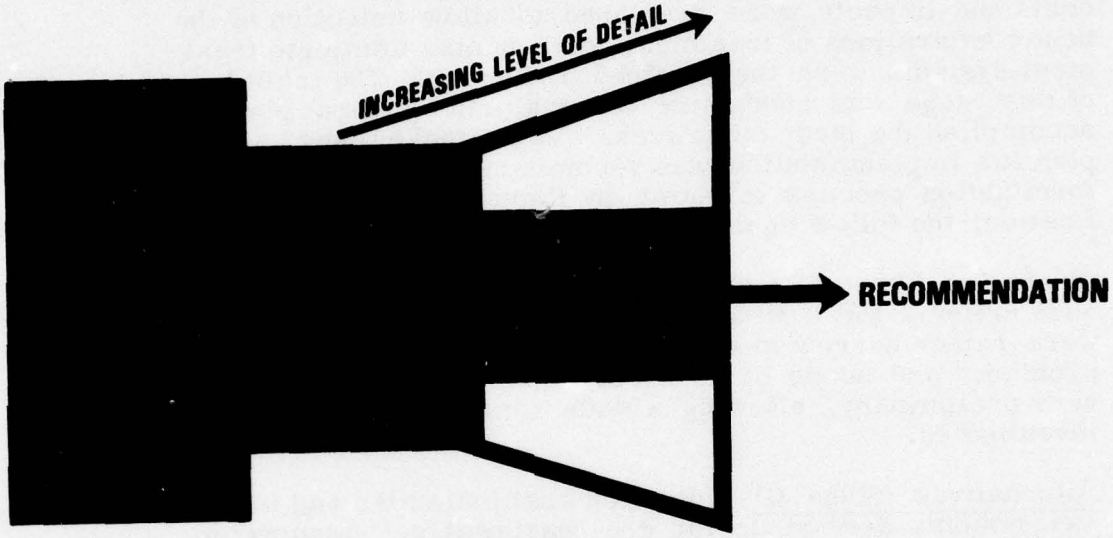
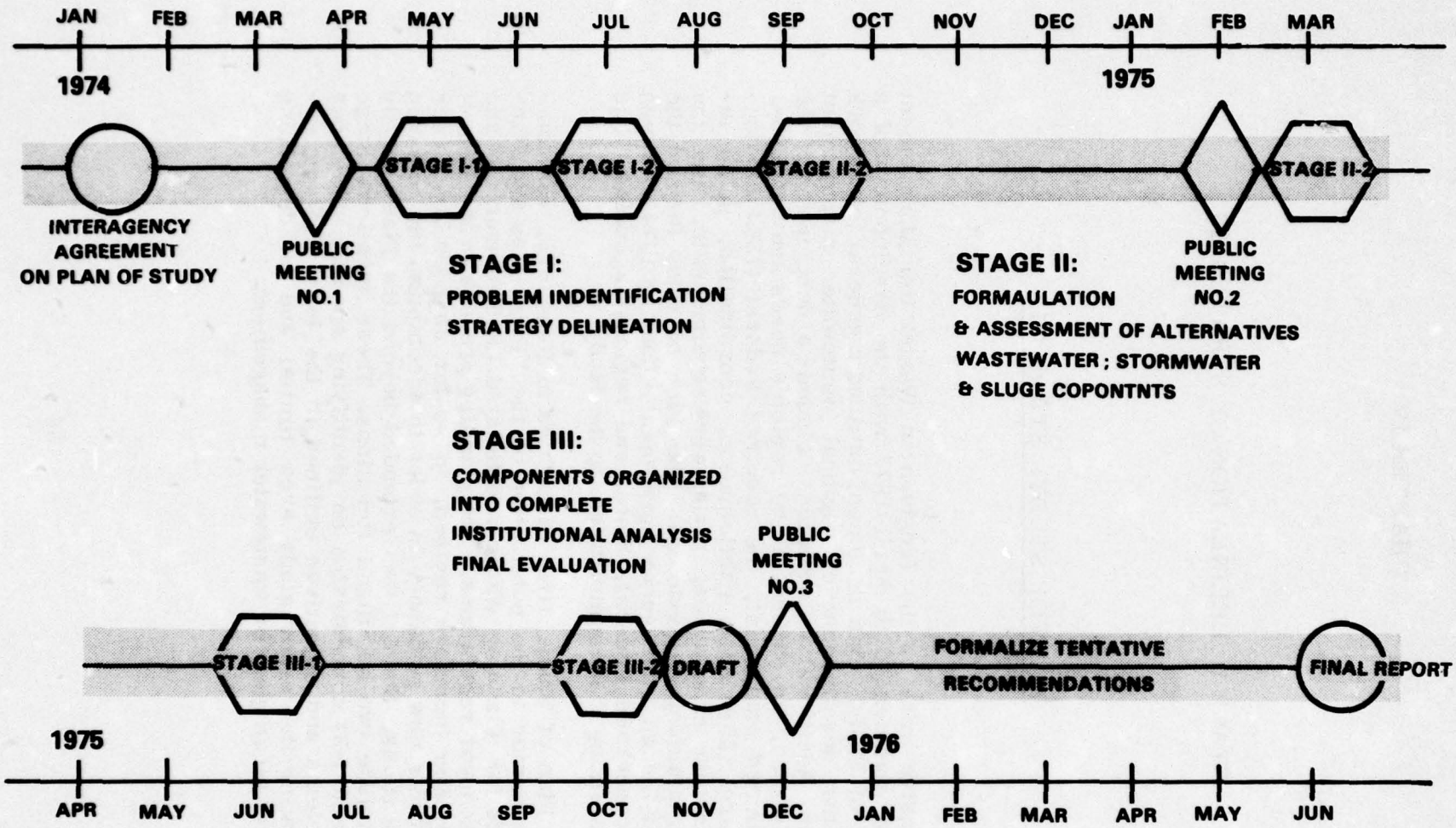


FIGURE I-2

FIGURE III-3 SEQUENCE OF STUDY STAGES AND ITERATIONS



CHAPTER IV

STAGE I: DELINEATION OF STRATEGIES

PLAN OF STUDY: STAGE I-1

Intensive work on the Binghamton Wastewater Management Study commenced in April 1973 with the development of a Plan of Study. This document outlined a general framework for the development of regional wastewater management plans. Additional information included: a description of the study area, an outline of the region's needs and concerns, estimated study cost, the required Federal (75%) and non-Federal (25%) study participation, coordination, public involvement procedures, manpower requirements, and the basic planning methodology. The Plan of Study formed the basis for an interagency agreement (January 1974) between the concerned Federal, State, and regional agencies, thus formalizing their commitment to the Study.

The Plan of Study, first circulated in June 1973, was completed prior to the publication of the "Principles and Standards for Planning Water and Related Land Resources" and subsequent regulations. The planning process in the Plan of Study was therefore revised, in so far as possible, to reflect this new guidance. In order to accomplish the required work items, Stage I was extended beyond the Plan of Study to include two additional iterations. These iterations (Stage I-2 and I-3) concentrated on identifying specific study area problems and objectives outlined in the Plan of Study; delineating the exact study area limits; and on developing initial strategies for wastewater management.

WASTEWATER MANAGEMENT PROBLEMS AND CONCERNS

SOURCES OF WATER POLLUTION

Sources of water pollution in the area include point source wastewater discharges from industries and municipal treatment plants, and non-point source pollution associated with urban and rural stormwater runoff. Existing municipal and industrial wastewater discharge characteristics arepresented in the Background Information Appendix. Almost 95 percent of the municipal wastewater flow is handled by four secondary sewage treatment plants (STP) and the remaining flow by three primary systems. The only major industrial pollution source was the GAF plant in Binghamton. Construction of a sewer connection to allow discharge of its wastewater to the Binghamton-Johnson City STP after pretreatment is scheduled for completion in 1976.

The major non-point pollution sources in the area are overflows from the City of Binghamton's combined sewer system. During storm periods, these overflows result in significant discharges of raw sewage and urban drainage waters to the Susquehanna River. There is little evidence of any significant problems from rural runoff. Coliform levels and nitrogen and phosphorus concentrations are low in the Susquehanna River above Binghamton and in the Chenango and Tioughnioga Rivers.

MAINTENANCE OF EXISTING WATER QUALITY STANDARDS

State water quality standards for dissolved oxygen (DO) in the Susquehanna, Chenango, and Tioughnioga Rivers specify: "For non-trout waters, the minimum daily average shall not be less than 5 mg/l. At no time shall the DO be less than 4 mg/l." Present wastewater discharges, during critical low river flows, would result in minimum DO levels of 4-5 mg/l when all municipal effluents receive secondary treatment. Due to increasing wastewater flows, DO levels would drop even lower in future years. The effect of existing and year 2020 discharges on stream DO during dry weather low flows is shown in Figure IV-1.

DISSOLVED OXYGEN PROFILES: EXISTING AND BASELINE CONDITION (MA-7-CD-10 FLOW)

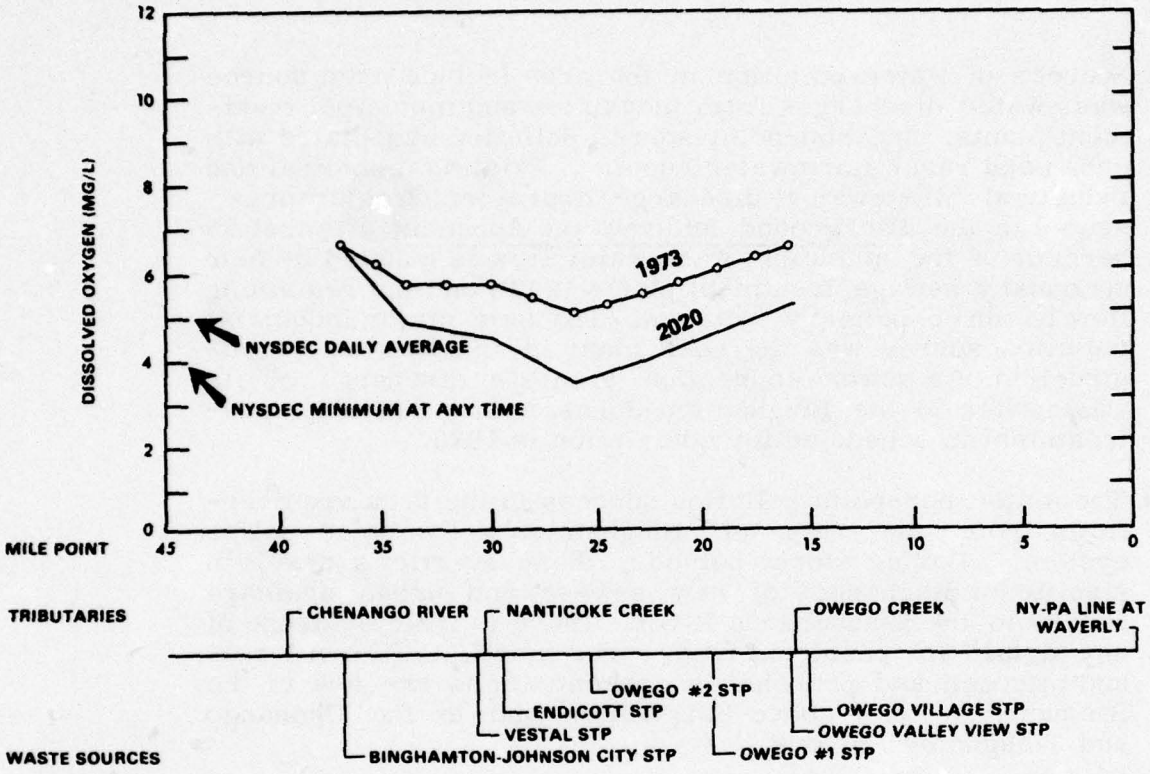


FIGURE IV-1

Urban runoff and discharges of raw sewage into waterways from combined sewer overflows will presently depress DO levels to below 4 mg/l during certain storm conditions. These overflows contribute substantially to the high coliform levels which currently result in violation of bacteriological standards. With only secondary treatment of wastewater, DO levels would drop to 3-4 mg/l by the year 2020.

At this time, there is little evidence of violation of water quality standards for parameters other than DO and coliform. Moreover, low DO levels and coliform violations are associated with effluents from municipal treatment plants and combined overflows and not with either industrial discharges or rural runoff.

PROVISION FOR COLLECTION AND TREATMENT OF WASTEWATER

Comparison of projected wastewater flows with existing capacities of municipal STP's indicated that present secondary facilities at West Owego would be overloaded by 1980. The Endicott treatment plant could be similarly overloaded by 1980 with the addition of wastewater flows from Vestal and portions of the Town of Maine.

Also, new sewage collection systems will be required in the Chenango Valley, Five Mile Point, and Nanticoke Valley wastewater management areas in coming years.

Some urban sectors which are not presently sewered have experienced problems with their septic systems due to improper construction or maintenance, poor soil conditions, or backflows from rivers during flooding. Septic system failures in the Broad Acres section of Fenton and Broome Community College (Chenango Valley) have resulted in sewage contamination of surface waters. As yet, there have been no reported occurrences of groundwater contamination due to septic system failures. However, improper functioning of septic systems combined with poorly suited soils, such as exists in the Chenango River Valley, may result in pollution of both ground and surface waters.

ENHANCEMENT OF RECREATION AND SCENIC OPPORTUNITIES

The goal of the Broome and Tioga Counties' Riverbanks Improvement Program is the development of parklands along the Chenango and Susquehanna Rivers. The value of such parkland would be enhanced by the maintenance of water quality conditions suitable for the propagation of fish and for swimming. The present stream classification (Class C) in the Binghamton and Owego Village segments of the Susquehanna River does not provide for swimming. Furthermore, coliform bacteria concentrations in several stretches of the Susquehanna River currently do not meet stream standards for primary contact recreation. However, since current water quality standards for DO in both Class B (which provides for swimming) and Class C waters are equivalent, the former could be achieved by maintenance of the more stringent coliform levels contained in Class B standards.

INFILTRATION/INFLOW (I/I) AND COMBINED SEWER OVERFLOWS

Infiltration is the water that enters a sewer system from the ground or nearby river through such means as defective pipes, pipe joints, overflow regulators and manhole walls. Infiltration occurs when existing sewer lines deteriorate or when new sewer lines are poorly designed and constructed. Infiltration increases the hydraulic load on treatment facilities as well as on interceptor lines and may require expansion of treatment plant capacity. The Binghamton-Johnson City Joint Sewage Treatment Plant was planned to be a regional facility to handle flows from surrounding urban areas. Due to infiltration problems (average 7. mgd), the plant may not be capable of serving these additional areas. The City of Binghamton has conducted an I/I study to define the sources of these flows and is commencing a sewer evaluation study to determine possible correctional measures.

Inflow normally occurs when rainfall enters a sewer system through direct connections such as roof leaders and catch basins. In a combined sewage system, municipal and industrial wastewater and stormwater runoff are placed in the

same pipe leading to a sewage treatment plant (STP). When this system is overloaded by stormwater and infiltration, the STP is bypassed and untreated wastes from municipal and industrial sources, as well as stormwater runoff, is discharged directly to receiving streams.

Overflows from the City of Binghamton's combined sewer system are a major pollution source. During storm periods, these overflows result in significant discharges of raw sewage and urban drainage to the Susquehanna River. Regardless of treatment plant performance, combined overflows will depress river DO concentrations to below 4 mg/l during certain storm periods. Overflows of combined sewers during heavy rains not only constitute a health hazard which is reflected in high coliform counts and prohibition of swimming in many locations, but also create stressful aquatic conditions in the Susquehanna River. The problems to future aquatic ecology, however, are even more critical considering the possible effects of large overflows coupled with low river flows. Aquatic organisms may be subject to DO concentrations as low as 3 mg/l for several hours or days depending on river flow conditions and rainfall intensity.

The Federal Water Pollution Control Act Amendments of 1972 place strong emphasis on control of urban runoff. Section 212(2)(B) mentions methods such as preventing, abating, reducing, storing, treating, separating, or disposing of stormwater runoff in municipal wastewater systems where such methods are cost-effective. Rules and regulations for construction grants for waste treatment works require that all applicants for grant assistance demonstrate that each sewer collection system discharging into such treatment works is not subject to excessive inflow/infiltration, (i.e., excessive being the amount of flow for which it is cheaper to eliminate by such means as sewer rehabilitation than to treat at the STP).

FEDERAL AND STATE WATER QUALITY REQUIREMENTS

The Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) specifies a number of objectives and requirements for wastewater management. In order to be eligible for Federal funding, municipal sewage treatment plants (STP's) must provide "Best Practical Waste

Treatment Technology" (BPWTT), currently defined as the necessary measures providing for the protection and propagation of aquatic life and for primary contact recreation (swimming). In addition to this requirement associated with funding, P. L. 92-500 establishes deadlines for minimum levels of treatment for municipal plants discharging into surface waters. Municipal STP's must achieve secondary treatment by 1977 and BPWTT by 1983. Minimum treatment levels for existing industrial discharges are "Best Practical Control technology Currently Available" by 1977 and "Best Available Treatment Economically Available" by 1983. New industrial discharges must achieve treatment levels specified in "New Source Performance Standards" to meet "Best Available Demonstrated Technology." Table IV-1 summarizes P. L. 92-500 requirements.

All wastewater treatment plants scheduled to be operational in 1977 are to comply with secondary treatment standards as defined by the Environmental Protection Agency (EPA): a monthly average of less than 30 mg/l and a minimum removal of 85 percent of the biochemical oxygen demand and suspended solids (see 17 August 1973 Federal Register). If the Vestal primary STP and Valley View Imhoff Tank are phased out of service as presently planned, then only the Owego Village STP would need to be upgraded from primary to secondary treatment. A proposal for upgrading this plant to a secondary treatment system has been filed with the New York State Department of Environmental Conservation. Some of the existing secondary STP's may require modifications to achieve the required effluent levels. During 1973, the Endicott STP and the Town of Owego STP #1 averaged only 75-80% removal of biochemical oxygen demand and suspended solids. Both of these plants employ trickling filter secondary systems.

P. L. 92-500 defines water quality goals sufficient to provide for primary contact recreation and the protection of aquatic life wherever attainable by 1983. The 1983 goal of Best Practicable Waste Treatment Technology (BPWTT) for municipal plants is not being defined as a blanket requirement for either effluent quality or specific processes by EPA. Rather, as indicated in "Alternative Waste Management Techniques for Best Practical Waste Treatment" (EPA, March 1974), the degree of BPWTT will be determined by the nature of the receiving waters. In particular, "protection of DO levels will most frequently have the highest priority once secondary treatment levels have been obtained."

TABLE IV-1

REQUIREMENTS OF FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS, P. L. 92-500

Point Source	Level of Control
By 1977:	
Publicly owned treatment works (POTW's)	Secondary Treatment
Sources other than POTW's (Industries)	Best Practicable Control Technology Currently Available (BPT)
By 1983 (fishable/swimmable):	
Publicly owned treatment works (POTW's)	Best Practicable Waste Treatment Technology (BPWTT)
Sources other than POTW's	Best Available Control Technology Economically Available (BAT)
Following Publication of Proposed Standards:	
New sources other than POTW's	New Source Performance Standards (NSPS)
Within Three Years of Promulgation:	
Sources discharging into POTW's	Pretreatment Standards

The oxidation of nitrogenous matter contained in secondary effluent is a major source of oxygen depletion in receiving streams and it is noted that "extension of treatment to include seasonal nitrification may well constitute best practicable treatment." Removal of nutrients such as nitrogen and phosphorus may also be a requirement of BPWTT to control eutrophication where receiving waters are either lakes or slow moving estuaries.

For purposes of plan formulation, the 1983 goal of fishable/swimmable waters was defined as the degree of treatment necessary to meet New York State Class B waters, i.e., to maintain a minimum daily average DO level of 5 mg/l and at no time dropping below 4 mg/l with a total coliform concentration less than 2,400 MPN/100 ml. These standards can be achieved by either treatment (secondary plus removal of some of the nitrogenous oxygen demand - NOD) and discharge to receiving waters or, alternatively, by wastewater application to the land.

For industries, the EPA has specified the 1977 and 1983 objectives to be "Best Practicable Control Technology Currently Available" and "Best Available Control Technology Economically Achieveable," respectively. The various treatment levels required for different categories of industries are currently being specified by the EPA. Most of these were proposed guidelines and have periodically been amended into regulations. Industries discharging to public STP's must comply with pretreatment guidelines to protect the operation of the municipal plant, and to prevent industrial pollutants not removable by municipal treatment from passing through inadequately treated. Industries discharging directly to rivers must obtain a permit under the National Pollutant Discharge Elimination System (NPDES). The NPDES permits set the limitations on pollution loads that an industry can discharge to a watercourse after considering numerous factors such as the nature of the waste, amount of product manufactured, water usage, and stream classification.

A final element of P. L. 92-500 is the national goal of "zero discharge" of pollutants by 1985. This goal is not a legal requirement nor has it been operationally defined at this time. It does, however, provide motivation for consideration of the highest feasible treatment levels. Since the EPA has not yet published effluent limitations for the 1985 goal, the Corps of Engineers' interpretation (as stated in the 3 November 1975 Federal Register) was used for planning purposes.

INDUSTRY

In Broome and Tioga Counties, the major industries discharging to streams are the plating industry, gravel washing operations, a power plant, photographic equipment manufacturing, and aerospace control systems equipment manufacturing. The only major industrial pollution source is the GAF photographic equipment and supplies manufacturing company. This firm has plans to pretreat its 1 million gallons per day (mgd) of process wastewater and will discharge to sanitary sewers for further treatment at the Binghamton-Johnson City STP. A sewer connection from GAF to the City's sewer system will be completed in 1976. Table IV -2 summarizes the major industrial discharges in the Bicounty Area and Figure IV-2 shows the location of these discharges. Total industrial discharges for the two counties approach 95 mgd. About 85 percent (80 mgd) of this total is relatively nonpolluted cooling water from the New York State Electric and Gas plant in Johnson City. Further information on industrial wastewater management is presented in the Specialty Appendix.

SLUDGE

At present, the digested sludge generated from the seven STP's in the study area amounts to about 9.2 tons per day dry solids. Assuming 20 percent solids concentration in the dewatered sludge, the amount to be hauled for disposal is approximately 46.5 tons/day. As the cost associated with the processing and disposal of sludge varies from 25 to 50 percent of the total treatment cost, it is important that alternative methods of disposal and reuse be investigated for the region.

Sludge from the Binghamton-Johnson City Joint Sewage Treatment Plant (5.5 tons/day dry solids) has in the past been utilized as a soil conditioner for a private horticulture operation. However, as this arrangement is only temporary, alternative disposal plans are being investigated. The cost for handling the digested sludge is about $60/ton of dry solids.

TABLE IV-2

SUMMARY OF INDUSTRIAL DISCHARGES*

No.	Name	Quantity (mgd)	Type	Discharge Location**
A1	IBM, Owego	0.3-0.6	Treated plating waste	S.R. (MP 18.4)
A2	IBM, Owego	0.02-0.06	Cooling	S.R. (MP 18.5)
B	Robintech, Inc., Owego	0.10	Plating waste	Barnes Creek
C1	IBM, Glendale	0.038	Cooling	Nanticoke Creek
C2	IBM, Glendale	0.13	Cooling	Nanticoke Creek
D	Union Forging, Endicott	0.15	Cooling	S.R. (MP 31.5)
E	IBM, Endicott	2.52	Treated plating waste	S.R. (MP 32.5 via storm sewers
		1.80	Cooling	
F	Endicott Forging & Manufacturing, Endicott	0.014 0.022	Cooling	S.R. (MP 32.7) via storm sewers
G	GAF, Vestal	0.02	Cooling	Willow Run Creek via Small Creek
H	Barney & Dickinson, Vestal	1.0	Gravel washing, after settling	S.R
I	GE, Johnson City	0.23 0.49	Cooling process	Little Choconut Creek Little Choconut Creek

TABLE IV-2 (Continued)

No.	Name	Quantity (mgd)	Type	Discharge Location**
J1	NYSE & G,	79.1	Cooling	Little Choconut Creek
J2	Johnson City	2.23	Ash Pond Disch.	Little Choconut Creek
K1	Endicott-Johnson,	0.45	Cooling	Little Choconut Creek
K2	Johnson City	0.40	Ash Pond Disch.	via storm sewer
L	GAF, Binghamton	1.0	Process	Chenango River via
	GAF, Binghamton	3.48	Cooling	storm sewer
	Corbisell Quarries, Vestal	0.02	Gravel washing after settling	S R. via unnamed creek
	Allred Asphalt, Vestal	0.22	Cooling	S.R. via unnamed creek
	Central Asphalt	0.0011	Cooling	S.R via unnamed creek
	TOTAL	93.91		

* See Figure IV-2 for location.
** S.R. = Susquehanna River; MP = mile point from New York-Pennsylvania border near Waverly.
***Not shown on map.

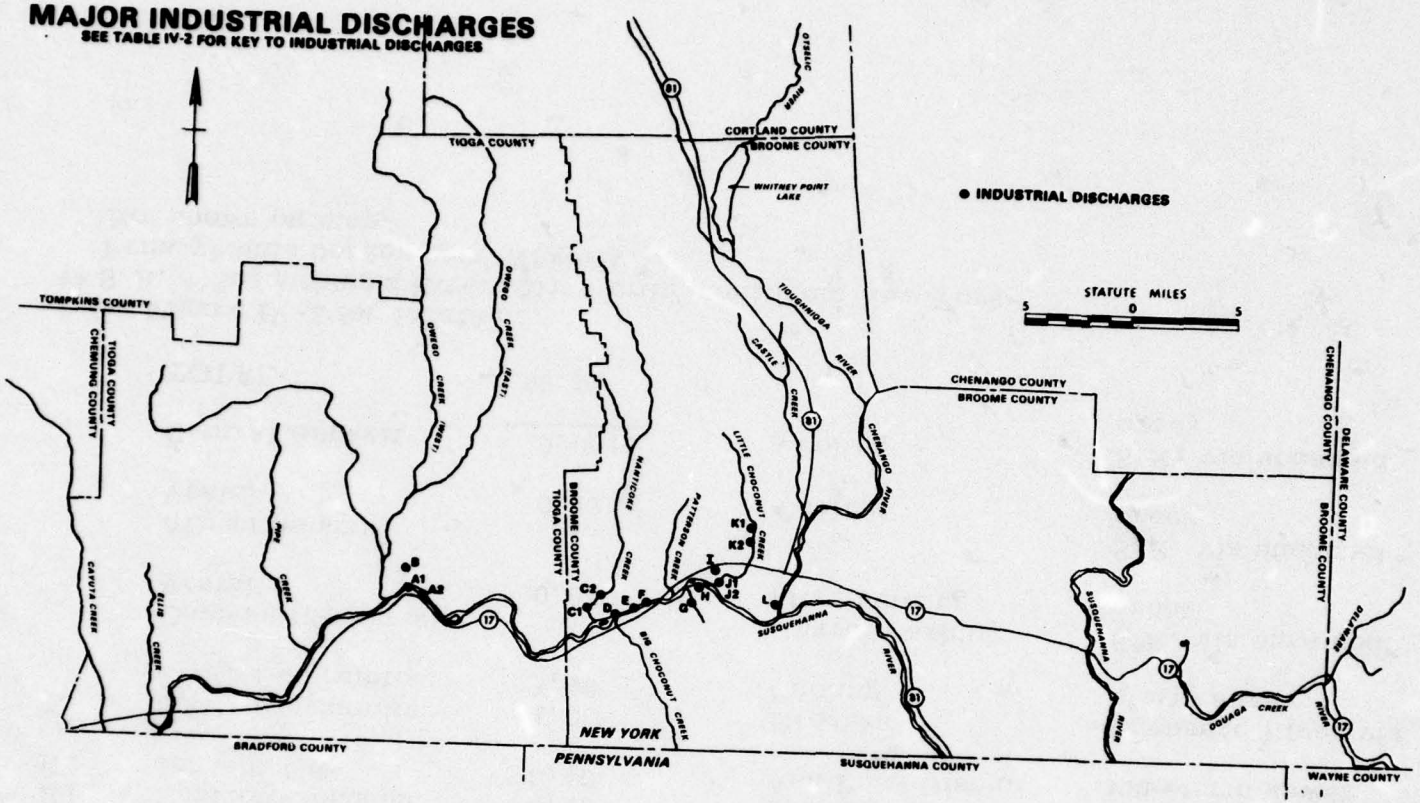

MAJOR INDUSTRIAL DISCHARGES
SEE TABLE IV-2 FOR KEY TO INDUSTRIAL DISCHARGES
● INDUSTRIAL DISCHARGES
STATUTE MILES
5 0 5
OTSELIC RIVER
CORTLAND COUNTY
BROOME COUNTY
TIOGA COUNTY
WHITNEY POINT LAKE
TOMPKINS COUNTY
TIOGA COUNTY
CHEMUNG COUNTY
OWEGO CREEK (EAST)
OWEGO CREEK (WEST)
TIOUGHNIOGA RIVER
CASTLE CREEK
CHENANGO COUNTY
BROOME COUNTY
CHENANGO RIVER
CHENANGO COUNTY
DELAWARE COUNTY
BROOME COUNTY
TIOGA COUNTY
BROOME COUNTY
MAPLETON CREEK
PATTERSON CREEK
LITTLE CHOCONUT CREEK
SUSQUEHANNA RIVER
BIG CHOCONUT CREEK
CAYUTA CREEK
ELLIS CREEK
PARK CREEK
OQUAGA CREEK
OSTRANDER RIVER
NEW YORK
PENNSYLVANIA
BRADFORD COUNTY
SUSQUEHANNA COUNTY
WAYNE COUNTY
17
81

FIGURE IV-2

During January-May 1974, the daily gas production from the digesters was 130,000 cubic feet/day. During the winter, 80-90 percent of this gas is used for heating the digesters but during the summer, only 30 to 40 percent of the gas is utilized and the rest is wasted.

Sludge from the Endicott STP and solid waste from the Village of Endicott and the Town of Union are disposed on a 55-acre landfill site along the north bank of the Susquehanna River. No information is presently available on the possible leaching of pollutants from the sludge or solid waste into the river. The costs for handling the 2.6 tons dry solids/day digested sludge is about $39/ton.

Final sludge disposal is currently not a problem at the remaining STP's as there is usually a good agricultural demand for most of the sludge for use as a soil conditioner.

The gas produced in the Owego Village STP is burned rather than utilized for heating the digesters due to a malfunction in the heating system. The system will be redesigned if upgraded to a secondary treatment plant.

The Owego Village-Valley View STP consists of a two story Imhoff Tank in which sedimentation is accomplished in the upper compartment and digestion in the lower. Scum accumulates in vents adjoining the sedimentation compartment. Gas produced in the digestion process escapes through the vents and is an odor nuisance for the nearby area. The Valley View plant is scheduled to be phased out after the construction of a southside interceptor to transport the waste to the Owego Village treatment plant. Construction of the interceptor is scheduled for 1976.

RURAL RUNOFF

There is little indication of either point or non-point pollution sources in the Susquehanna River upstream of Binghamton or in the Chenango and Tioughnioga Rivers. Coliform levels are low and long term New York State nutrient sampling data indicate concentrations of nitrogen and phosphorus at levels normally associated with undisturbed or forested drainage areas. Approximately 17 percent and 27 percent of the land in Broome and Tioga Counties, respectively, is currently utilized as farmland. Agricultural pollution is

normally associated with concentrated agricultural practices such as large dairy farms and heavily fertilized cropland. However, neither activity in Broome and Tioga Counties is of a sufficient level to constitute a major pollution source in the area.

Erosion due to construction and agriculture can result in sediment pollution of waterways. Reported suspended solids concentrations and turbidity levels, however, are not indicative of significant erosion problems. Thus, there appears to be little evidence that rural nonpoint source pollution is a major water quality problem at the present time. Chapter III of the Specialty Appendix addresses this problem more fully.

CAPACITY OF THE BINGHAMTON-JOHNSON CITY JOINT SEWAGE TREATMENT PLANT

Because the Binghamton-Johnson City STP is by far the largest and one of the newest plants in the area, its performance has implications for planning throughout the Urban Study Area. In assessing the existing and future wastewater management situation, an estimate of the ability of this plant to handle and treat wastewater loads is important. This importance derives from the fact the plant was recently completed in 1973 and has a significant useful life remaining; and from the number of wastewater inputs which the plant does or could receive. The treatment plant was designed for an average flow of 18.25 mgd but an analysis of operating records indicates this estimate may not be precise. An engineering determination was made of plant capacity for parameters such as: hydraulic capacity, BOD, NOD, and suspended solids (see Design and Cost Appendix). Knowledge of the plant capacity facilitated decisions as to the amount of service area expansion allowable and the cost effective degree of stormwater and infiltration control.

OBJECTIVES

Planning objectives served to guide the formulation of plans and were used in evaluating the effectiveness of each plan. They were based upon an identification of the problems, concerns, and needs of the region, and on State and Federal requirements.

The Binghamton Wastewater Management Study provided a range of plans that were compatible with the comprehensive regional development policies for the Bicounty Area. Specific wastewater management plans were formulated to meet the objectives of the Study through the planning period to the year 2020.

As stated in Chapter III, all water resources projects are planned to achieve two national objectives, (1) National Economic Development and (2) Environmental Quality.

Within the context of these two broad national objectives, specific planning objectives for the study area were defined. They were derived from Federal and State requirements and from regional and local problems and issues. Table IV-3 summarizes the specific Study objectives.

The objectives were identified through meetings and discussions with local individuals, county planning officials, and New York State and Federal water resource planners. The management structure (Interagency Study Management Group, Citizens Advisory Committee, and Technical Advisory Committee) provided the primary mechanism for identification of the local and regional needs.

WASTEWATER MANAGEMENT AREAS

For planning purposes, 18 wastewater management areas were designated in Broome and Tioga Counties. With the exception of Harpursville, these areas were identified in the Southern Tier East Regional General Plan as having a potential for future development. Harpursville was included because of the pollution potential it may exert on the Susquehanna River due to growth stimulated by the completion

TABLE IV-3

BINGHAMTON WASTEWATER MANAGEMENT
STUDY OBJECTIVES

A. Achieve the minimum standards defining secondary treatment by 1977 at all wastewater treatment plants in the Bicounty Area.

   1. Achieve NYSDEC water quality standards for the Susquehanna, Tioughnioga, and Chenango Rivers.

   2. Reduce the occurrence of combined sewer overflows by controlling the volume of infiltration and inflow to the sewer system.

B. Plan for fishable-swimmable waters for the Bicounty Area in accordance with the 1983 goals for interim water quality.

   1. Provide adequate wastewater collection and treatment facilities to accommodate projected growth in the Urban Study Area.

   2. Outline general course of action for wastewater management in the outlying communities.

   3. Achieve pretreatment standards, effluent limitations, or waste load allocations specified by EPA for industrial discharges.

   4. Consider sludge and sludge by-products as recyclable resources to be used for beneficial purposes.

   5. Enhance recreational and scenic opportunities associated with the Riverbanks Improvement Program by providing "Class B" waters from Binghamton to Owego Village.

C. Investigate alternative methods for achieving the 1985 "no discharge" goal.

of Interstate Highway 88. The Village of Deposit was not included as it lies outside of the Susquehanna River Basin. Wastewater management areas did not necessarily conform to municipal boundaries, but rather included sewerage service areas which could be reasonably incorporated into a single management district. Thus, for example, the Binghamton-Johnson City area includes portions of the Towns of Binghamton, Conklin, Dickinson, Union (although portions of the Town of Vestal are currently served by the Binghamton-Johnson City Sewage Treatment Plant, Vestal was considered a separate management area due to its high growth rate). Characteristics of each wastewater management area are summarized in Table IV-4.

The wastewater management areas were divided into urban and outlying regions, with the first nine areas being the urban core which was the focus of the Study (Figure IV-3). These nine wastewater management areas, constituting the Urban Study Area, were Binghamton-Johnson City, Endicott, Vestal, Nanticoke Valley, Chenango Valley, and Five Mile Point in Broome County; and East Owego, West Owego, and Owego Village in Tioga County. The nine Outlying Communities are discussed in the Specialty Appendix where general wastewater management alternatives were developed for these areas, but no detailed plans.

TABLE IV-4

CHARACTERISTICS OF WASTEWATER MANAGEMENT AREAS

Wastewater Management Area	Existing Sewers	Comments
URBAN STUDY AREA		
1. Binghamton-Johnson City	Yes	Served by secondary sewage treatment plant (STP). Proposed sewer extensions to area 7 and 8. Combined sewer overflows and infiltration problems. Major industrial discharges. Both separate and combined sewers.
2. Endicott	Yes	Secondary STP. Some sewer expansion in Union. Sewers partially combined. Major industrial discharge.
3. Vestal	Yes	Primary STP to be abandoned. Planned interceptor for West Vestal to Endicott. East Vestal served by Binghamton-Johnson City STP. Separate storm sewers. Planned expansion of service area in West Vestal.
4. East Owego	Yes	Secondary treatment at Town of Owego STP No. 2. Separate sewers but some infiltration/inflow problems.
5. West Owego	Yes	Secondary treatment at Town of Owego STP No. 1. Both separate and combined sewers. Major industrial discharges.
6. Owego Village	Yes	Plans to upgrade primary plant to secondary. Sewers partially combined. Infiltration problems. Valley View Imhoff tank to be abandoned.
7. Nanticoke Valley	No	Proposed future growth area and planned sewer hookup with Endicott STP.
8. Chenango Valley	No	Planned sewering. Connection to either Binghamton-Johnson City STP or separate Chenango Valley STP.
9. Five Mile Point	Yes	Some sewering with additional extensions planned to be hooked up to Binghamton-Johnson City STP.

TABLE IV-4 (Continued)

Wastewater Management Area	Existing Sewers	Comments
OUTLYING COMMUNITIES*		
10. Windsor	No	Septic tanks.
11. Harpursville	No	Septic tanks.
12. Whitney Point	No	Some evidence of septic tank failure.
13. Lisle	No	Septic tanks.
14. Newark Valley	No	Some evidence of septic tank failure.
15. Candor	No	Septic tanks.
16. Spencer	No	Septic tanks.
17. Nichols	No	Septic tanks.
18. Waverly	Yes	Partial sewering in Village, raw discharge. Proposed sewering and secondary treatment plant, but status uncertain.

*See Specialty Appendix for further information.

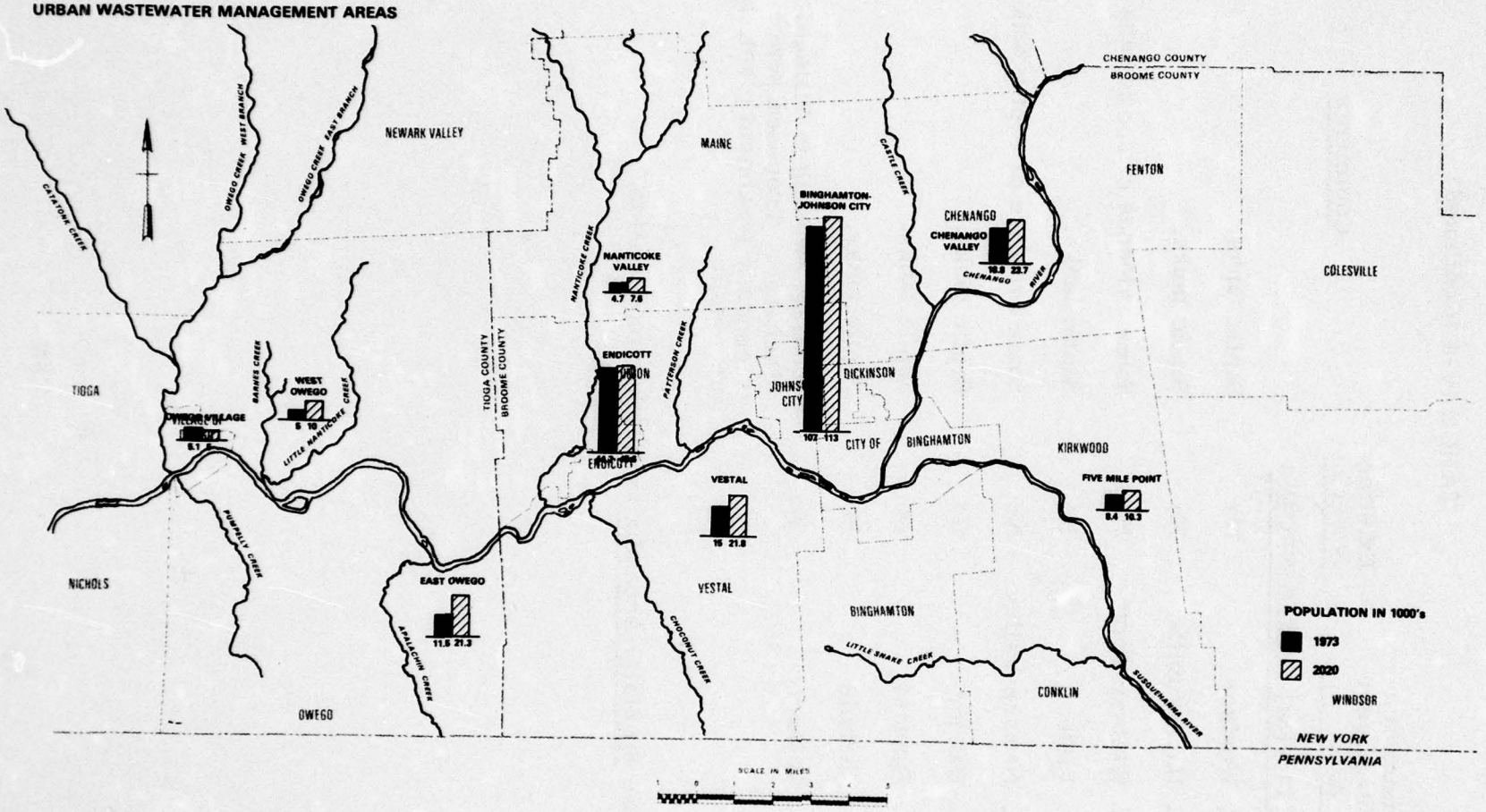

URBAN WASTEWATER MANAGEMENT AREAS
NEWARK VALLEY
MAINE
FENTON
CHENANGO COUNTY
BROOME COUNTY
COLESVILLE
TIOGA
NICHOLS
OWEGO
VESTAL
BINGHAMTON
CONKLIN
KIRKWOOD
DICKINSON
CITY OF BINGHAMTON
JOHNSON CITY
ENDICOTT
WEST OWEGO
EAST OWEGO
NANTICOKE VALLEY
CHENANGO VALLEY
BINGHAMTON-JOHNSON CITY
FIVE MILE POINT
TIOGA COUNTY
BROOME COUNTY
OWEGO CREEK WEST BRANCH
OWEGO CREEK EAST BRANCH
CATATONK CREEK
BARNES CREEK
LITTLE NANTICOKE CREEK
NANTICOKE CREEK
PATTERSON CREEK
CASTLE CREEK
CHENANGO RIVER
PUMPKIN CREEK
APALACHIN CREEK
CHOCONUT CREEK
LITTLE SNAKE CREEK
SUSQUEHANNA RIVER
POPULATION IN 1000's
1973
2020
NEW YORK
PENNSYLVANIA
SCALE IN MILES

FIGURE IV-3

WASTEWATER FLOW PROJECTIONS

As wastewater treatment and collection facilities have useful lives exceeding 25 years, it is necessary to plan for the coming years by developing projections of future wastewater flows. These projections are inherently uncertain as they are based on such factors as population forecasts, future water usage, projected sewering, and location of industrial development. Also, the provision of sewers for meeting anticipated needs may, in fact, stimulate growth and development to the extent that projected flows are exceeded. The installation of interceptors, therefore, not only satisfies requirements for wastewater services, but may also create new demands for additional services.

Wastewater flow projections were developed for the Binghamton metropolitan area by considering the following:

a. Current water use and wastewater flows.

b. Projected population growth.

c. Anticipated location and growth of commerce and industry.

d. Sewer service areas.

e. Changes in per capita water use and wastewater production.

f. Present condition and anticipated rehabilitation of sewer systems.

The Southern Tier East Region General Plan (Egner and Niederkorn Assoc., Vol. 4, 1972) was used as a guide in determining land use changes and new growth.

CURRENT WASTEWATER FLOWS AND WATER USE

Wastewater Flows

A starting point for wastewater projections is the current per capita flows to existing sewerage treatment plants (Table IV-5). The Binghamton-Johnson City sewage collection system is of the combined type and is subject to considerable infiltration and inflow (I/I). The base wastewater flow (flow exclusive of infiltration and inflow) has been estimated to be 10.8 mgd. With the addition of GAF industrial wastewater flow, and the possible treatment of sewage from Broome Community College, this base flow would increase to 11.9 mgd, corresponding to a base per capita flow of 115 gallons per capita per day (gpcd).

The difference in average plant flows and current base flows is 7.5 mgd (18.3 - 10.8) and can be considered the average annual infiltration and inflow to the Binghamton-Johnson City treatment plant.

TABLE IV-5

CURRENT AVERAGE PER CAPITA WASTEWATER FLOWS

Treatment Plant	Per Capita Flow (gallons per capita per day)			
	Total	Wastewater Production (Base Flow)	Estimated Infiltration/ Inflow	Current Plant Flow (mgd)
Binghamton-Johnson City	172	115	57	18.3
Endicott	93	78	15	4.3
Vestal	133			1.0
Owego Plant #1 (West Owego)	135			0.2
Owego Plant #2 (East Owego)	57	57	0	0.4
Owego Village	137			0.9

Exclusive of commercial and industrial sources, the Endicott Plant flow is estimated to be 3.5 mgd or 78 gpcd. Average residential wastewater production in the area is roughly 60 gpcd. Commercial sources amount to 0.8 mgd or 18 gpcd. Hence, Endicott currently has a base flow (exclusive of I/I) of 78 gpcd. The difference in flows is an estimate of infiltration/inflow to the plant, 15 gpcd or approximately 0.7 mgd.

The Vestal per capita flows are high for an area with separate sanitary sewers and no major industrial discharges. However, the reported wastewater flows are comparable to other flows in the region, particularly Owego.

Town of Owego Plant #1 (West Owego) handles wastewater flows from an IBM plant with approximately 5,000 employees, which accounts for the high per capita flows in an otherwise residential area.

Town of Owego Plant #2 (East Owego) has the lowest per capita flow (57 gpcd) in the region. This might be considered as typical for relatively new, well-maintained sanitary sewer systems in residential areas.

The Owego Village treatment plant is serviced by both combined and separate sewer systems. The sewers are subject to infiltration, thus contributing to the large per capita flow value.

Water Use

Average per capita residential water use in the Bicounty Area is 70 gallons per day in the non-sewered districts and 67 gallons per day in sewered districts. Within the non-sewered area, strong negative correlations exist between water consumption and both water metering and water cost. That is, increases in metering or water rates tend to decrease the residential water use. A weaker correlation between consumption and cost is evidenced in sewered districts. However, the mean water cost is substantially higher in sewered areas than in non-sewered areas, and at this higher rate, changes in water use may be less sensitive to rate variation.

The above results are referred to in later discussions of nonstructural measures for wastewater management. For

the purpose of wastewater projections, assuming that 90 percent of the residential water use appears as wastewater flows, an average residential quantity of 60 gpcd would be produced in sewered areas. This compares favorably with the Owego Plant #2 per capita wastewater flow of 57 gpcd.

PROJECTED POPULATION GROWTH

Population Projections by Sub-Municipal Area

Estimates of future population levels in Broome and Tioga Counties were presented in Chapter II. These projections were developed on a town and village basis. As the study area limits did not always coincide with municipal boundaries, the population projections were further broken down into submunicipal areas based on sewer, political, hydrologic, and topographic boundaries. In this way, future flows for wastewater management areas within the study area were then estimated. These sub-municipal projection areas are outlined in Figure IV-4 and described in Table IV-6. As several of these sub-municipal areas have a low density of present and expected future development and were not in need of centralized treatment, they were not included in the Urban Study Area. Those that are included were aggregated into the nine urban wastewater management areas previously discussed. The populations projections for each subarea are tabulated in Table IV-7 and were further disaggregated from the municipal total (Table II-4) using the ratio method (percent land of sub-area to total municipal area) as a general guide. Adjustments were made for factors such as topography, access, vacant land, and availability of commercial areas, schools, and other support facilities.

Table IV-7 also presents population estimates for 1973. These estimates were derived from various techniques. In many cases, estimates were based on house counts within each sub-area from 1973 Planimetric maps and from water connection records and water district maps. In addition, census data were used to compute the average number of persons per family. In areas where a significant number of multi-family dwellings were noted, a correction factor derived from census estimates was applied to the analysis. The 1973 population estimates were then obtained by multiplying the house counts for 1973 by the average number of persons per family (assumed to have remained constant since the 1970 census).

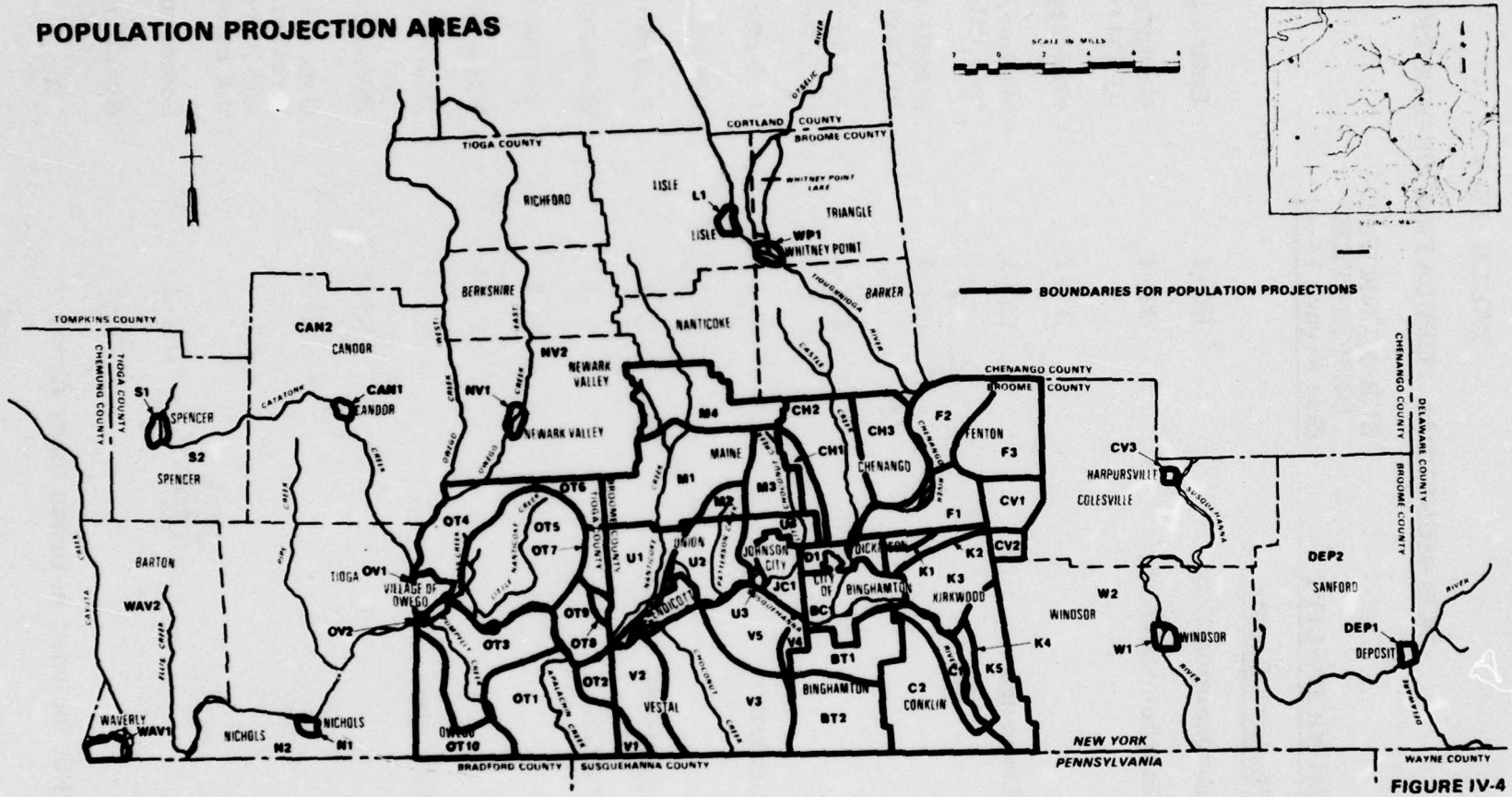

SUB-MUNICIPAL
POPULATION PROJECTION AREAS
BOUNDARIES FOR POPULATION PROJECTIONS
TOMPKINS COUNTY
TIOGA COUNTY
CORTLAND COUNTY
BROOME COUNTY
CHENANGO COUNTY
DELAWARE COUNTY
BRADFORD COUNTY
SUSQUEHANNA COUNTY
WAYNE COUNTY
NEW YORK
PENNSYLVANIA
RICHFORD
LISLE
L1
TRIANGLE
WP1
WHITNEY POINT
BERKSHIRE
NANTICOKE
BARKER
CAN2
CANDOR
CAN1
S1
SPENCER
S2
NV2
NEWARK VALLEY
NV1
M4
CH2
CH3
F2
FENTON
F3
MAINE
M1
M3
CH1
CHENANGO
CV3
HARPURSVILLE
COLESVILLE
CV1
F1
CV2
OT6
OT4
OT5
OT7
U1
U2
U3
U4
JOHNSON CITY
JC1
O1
BINGHAMTON
K1
K2
K3
KIRKWOOD
K4
K5
BC
BT1
BT2
C2
CONKLIN
V1
V2
V3
V4
V5
VESTAL
OT1
OT2
OT3
OT8
OT9
OT10
OV1
OV2
TIOGA
VILLAGE OF OWEGO
BARTON
WAV2
WAV1
WAVERLY
NICHOLS
N1
M2
W1
W2
WINDSOR
DEP1
DEPOSIT
DEP2
SANFORD

FIGURE IV-4

TABLE IV-6

SUB-MUNICIPAL POPULATION PROJECTION AREAS

MUNICIPALITY	SUB-MUNICIPAL DESIGNATION (See Figure IV-4)	DESCRIPTION
Broome County		
Binghamton City	BC-1	Entire City
Binghamton Town	BT-1	Northern half of town drained by Pierce and Boyle Creeks
	BT-2*	Southern half of town
Chenango	CH-1	Western part of town drained by Little Choconut Creek
	CH-2	Middle part of town, drained by Castle Creek
	CH-3	Eastern part of town, drained by Gilbert Creek
Conklin	C-1	Urbanized area along river
	C-2	Remainder of town
Dickinson	D-1	Entire town
Fenton	F-1	Southern portion of town
	F-2	Northern portion of town
	F-3*	Eastern portion of town
Kirkwood	K-1*	Phelps Creek Basin
	K-2*	Brandywine Creek area
	K-3	General area drained by Stratton Mill, Stanley Hollow, and Acrea Creeks. Includes the industrial park.
	K-4	Southern area along river
	K-5	Rural, eastern part of town

*Not included in Urban Study Area.

TABLE IV-6 (Continued)

MUNICIPALITY	SUB-MUNICIPAL DESIGNATION	DESCRIPTION
Broome County (Cont'd)		
Maine	M-1	Nanticoke Creek Basin to Maine Center
	M-2	Patterson Creek Basin
	M-3	Little Choconut Creek Basin
	M-4	Northern, rural areas
Endicott	E-1	Entire village
Johnson City	JC-1	Entire village
Union	U-1	Nanticoke Creek Basin
	U-2	Patterson Creek Basin
	U-3	Westover
	U-4	Little Choconut Creek
Vestal	V-1*	Appalachin Creek Basin
	V-2	Tracy Creek Basin
	V-3	Choconut Creek Basin (except area V-5)
	V-4	Eastern part of town in Fuller Hollow Creek Basin
	V-5	Portion of Choconut Creek Basin presently served by Binghamton-Johnson City STP
Tioga County		
Owego Village	OV-1	North of Susquehanna River
	OV-2	South of Susquehanna River

*Not included in Urban Study Area.

TABLE IV-6 (Continued)

MUNICIPALITY	SUB-MUNICIPAL DESIGNATION	DESCRIPTION
Owego Town	OT-1	Appalachin Creek Basin
	OT-2	Tracy Creek Basin
	OT-3	Pumpelly Creek Basin
	OT-4	Owego Creek Basin
	OT-5	Little Nanticoke Creek Basin
	OT-6*	Crocker Creek Basin
	OT-7*	Day Hollow Creek Basin
	OT-8*	Dead Creek Basin
	OT-9	Crestview Heights - Campville
	OT-10*	Portion draining to Pennsylvania and Hunts Creek.

*Not included in Urban Study Area.

TABLE IV-7

POPULATION PROJECTIONS FOR SUB-MUNICIPAL AREAS

Municipality	Sub-Area	1973	1980	1990	2000	2010	2020
Broome County							
Binghamton City	BC-1	62,820	60,200	57,900	57,900	58,400	60,000
Binghamton Town	BT-1	3,780	4,000	4,570	4,700	4,850	5,150
	*BT-2	1,390	1,500	1,650	1,700	1,750	1,850
	Total	5,170	5,500	6,220	6,400	6,600	7,000
Chenango	CH-1	410	420	450	480	500	530
	CH-2	5,840	5,850	6,250	6,420	6,600	6,720
	CH-3	6,780	6,800	7,200	7,400	7,600	7,750
	Total	13,030	13,070	13,900	14,300	14,700	15,000
Conklin	C-1	4,540	4,540	4,850	5,150	5,350	5,500
	C-2	1,210	1,210	1,270	1,350	1,450	1,600
	Total	5,750	5,750	6,120	6,500	6,800	7,100
Dickinson	D-1	5,690	5,370	5,150	5,100	5,200	5,300
Fenton	F-1	4,740	4,850	4,950	5,500	5,900	6,200
	F-2	1,490	1,600	1,720	2,300	2,550	3,000
	*F-3	530	570	630	900	950	1,000
	Total	6,760	7,020	7,300	8,700	9,400	10,200

*Not included in Urban Study Area

TABLE IV-7 (Continued)

Municipality	Sub-Area	1973	1980	1990	2000	2010	2020
Kirkwood	*K-1	110	110	120	130	150	160
	*K-2	240	240	250	260	300	320
	K-3	3,100	3,110	3,330	3,400	3,500	3,600
	K-4	1,580	1,590	1,700	1,800	1,900	2,050
	K-5	1,050	1,050	1,100	1,110	1,150	1,170
	Total	6,080	6,100	6,500	6,700	7,000	7,300
Maine	M-1	2,860	3,480	3,920	4,070	4,240	4,500
	M-2	290	330	400	430	450	500
	M-3	1,110	1,140	1,200	1,250	1,300	1,350
	M-4	1,600	1,820	2,350	2,450	2,500	2,650
	Total	5,860	6,770	7,870	8,200	8,490	9,000
Endicott	E-1	16,320	15,800	15,200	15,200	15,400	15,600
Johnson City	JC-1	17,750	17,400	16,880	16,900	17,100	17,300
Union	U-1	9,030	9,330	9,550	9,550	9,600	9,650
	U-2	19,360	19,800	20,230	20,250	20,350	20,400
	U-3	750	750	750	750	750	750
	U-4	860	900	950	950	1,000	1,000
	Total	30,000	30,780	31,480	31,500	31,700	31,800

*Not included in Urban Study Area.

TABLE IV-7 (Continued)

Municipality	Sub-Area	1973	1980	1990	2000	2010	2020
Vestal	*V-1	40	60	80	80	80	80
	V-2	1,710	2,080	2,500	2,600	2,620	2,660
	V-3	13,300	15,040	18,340	18,900	18,970	19,190
	V-4	6,960	8,400	9,600	10,200	10,580	10,720
	V-5	4,200	6,000	6,800	7,600	7,600	7,700
	Total	26,210	31,580	37,320	39,380	39,850	40,350
Tioga County							
Owego Village	OV-1	4,680	4,390	4,190	4,140	4,340	4,540
	OV-2	460	460	460	460	460	460
	Total	5,140	4,850	4,650	4,600	4,800	5,000
Owego Town	OT-1	3,960	4,300	7,000	7,400	7,670	8,000
	OT-2	4,200	5,230	6,000	6,300	7,100	7,300
	OT-3	1,500	1,730	2,610	2,800	2,840	3,100
	OT-4	960	1,270	1,300	1,350	1,400	1,450
	OT-5	2,620	2,800	4,400	4,800	5,070	5,400
	*OT-6	190	230	310	340	370	400
	*OT-7	180	230	310	340	370	400
	*OT-8	130	160	220	250	270	300
	OT-9	3,380	4,000	5,050	5,230	5,720	6,000
	*OT-10	480	550	600	650	700	750
	Total	17,600	20,500	27,800	29,460	31,510	33,100

*Not included in Urban Study Area.

Projections by Wastewater Management Area

As previously mentioned, the Binghamton urban area was divided into nine distinct wastewater management areas (WMA) as shown in Figure IV-3. The selection of WMA's was guided by the Southern Tier East Regional Planning Board's General Plan, and each wastewater management area corresponded to an area with either existing development or planned growth. Six areas (Binghamton-Johnson City, Vestal, Endicott, East Owego, West Owego, and Owego Village) were each based on the service areas of existing sewage treatment plants. Projected wastewater volumes were based not only on the present service areas, however, but also included unsewered areas contiguous to the wastewater management areas expected to experience growth. The three additional WMA's (Nanticoke Valley, Chenango Valley, and Five Mile Point) were either presently in need of sewage collection and treatment, as in the case of Chenango Valley, or were expected to exhibit sufficient future growth to require such services.

The sub-municipal population projection areas described in the previous section were aggregated within their respective wastewater management areas as indicated in Table IV-8. Population projections were summed for each wastewater management area in Table IV-9. Figures IV-5 and IV-6 display these forecasts graphically. The population given was that expected to be sewered regardless of which plan was implemented. However, estimated 1973 values did not represent presently sewered populations since in several cases only a portion of the wastewater management areas were currently sewered. The Study assumed that extensions of sewer service now planned in the Urban Study Area would be completed. Services now planned by regional authorities include providing sewerage for Nanticoke Valley, Chenango Valley, and Port Crane and connection of the Vestal sewer system to the Endicott treatment plant.

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TABLE IV-8

SUB-MUNICIPAL AREAS INCLUDED IN WASTEWATER MANAGEMENT AREAS

Wastewater Management Area	Sub-Municipal Projection Areas
Binghamton-Johnson City	BC-1, D-1, K-3, BT-1, V-4, V-5, U-3, JC-1, U-4, M-3, CH-1
Endicott	E-1, U-1, U-2
Vestal	V-2, V-3
East Owego	OT-9, OT-2, OT-1
West Owego	OT-5, OT-3, OT-4
Owego Village	OV-1, OV-2
Nanticoke Valley	M-1, M-2, M-4
Chenango Valley	CH-2, CH-3, F-1, F-2
Five Mile Point	C-1, K-4, K-5, C-2

TABLE IV-9

POPULATION PROJECTIONS FOR WASTEWATER MANAGEMENT AREAS

Wastewater Management Area	1973	1980	1990	2000	2010	2020
Binghamton-Johnson City	107,400	107,700	107,600	109,200	110,800	113,400
Five Mile Point	8,400	8,400	8,900	9,400	9,800	10,300
Chenango Valley	18,800	19,100	20,100	21,600	22,600	23,700
Endicott	44,700	44,900	45,000	45,000	45,300	45,600
Vestal	15,000	17,200	20,800	21,500	21,500	21,800
Nanticoke Valley	4,700	5,600	6,700	7,000	7,200	7,600
West Owego	5,100	5,800	8,300	9,000	9,300	10,000
East Owego	11,500	13,500	18,000	19,000	20,500	21,300
Owego Village	5,100	4,800	4,600	4,600	4,800	5,000
Total Urban Study Area	220,700	227,000	240,000	246,300	251,800	258,700

POPULATION PROJECTIONS FOR WASTEWATER MANAGEMENT AREAS

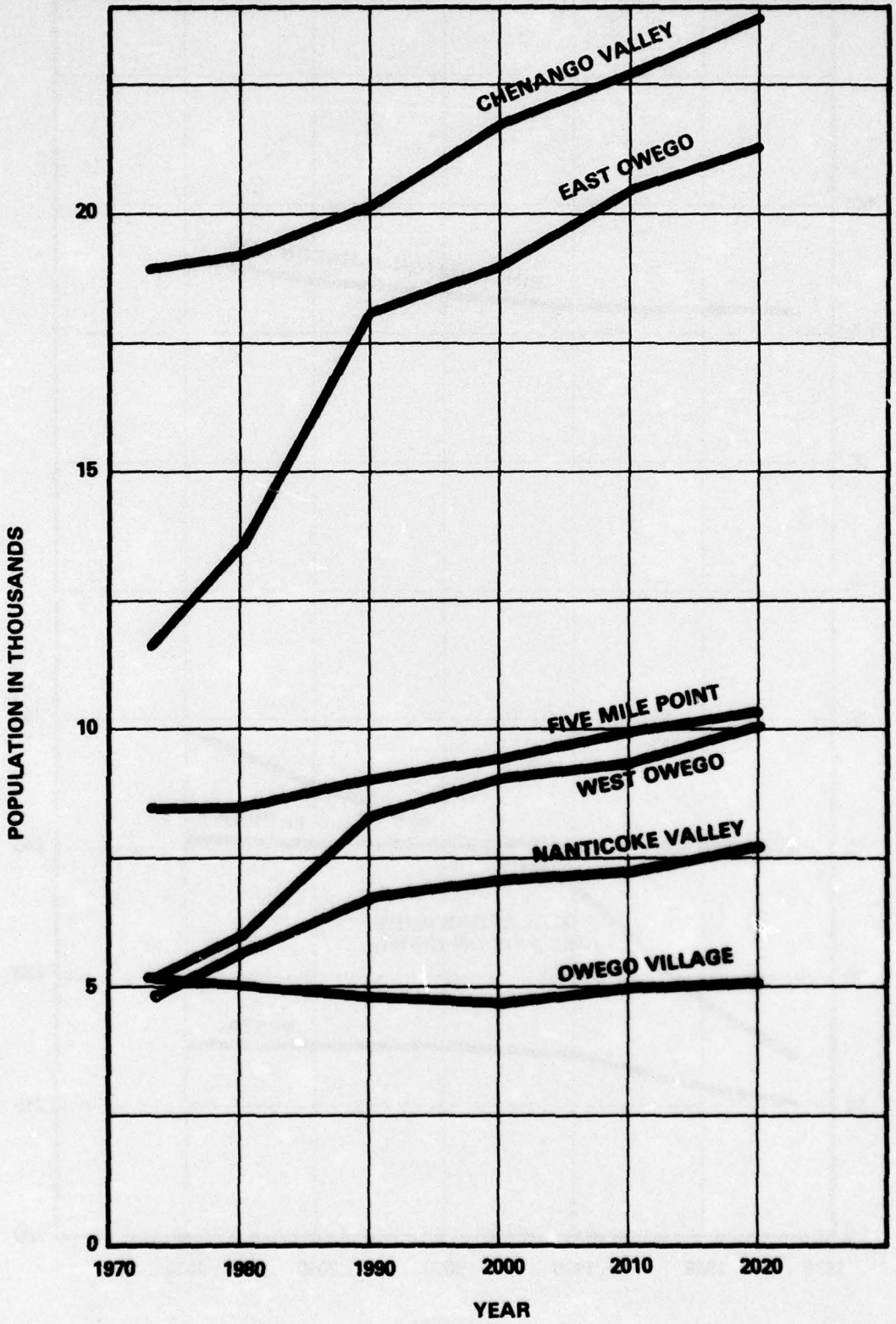


FIGURE IV-5

POPULATION PROJECTIONS FOR WASTEWATER MANAGEMENT AREAS

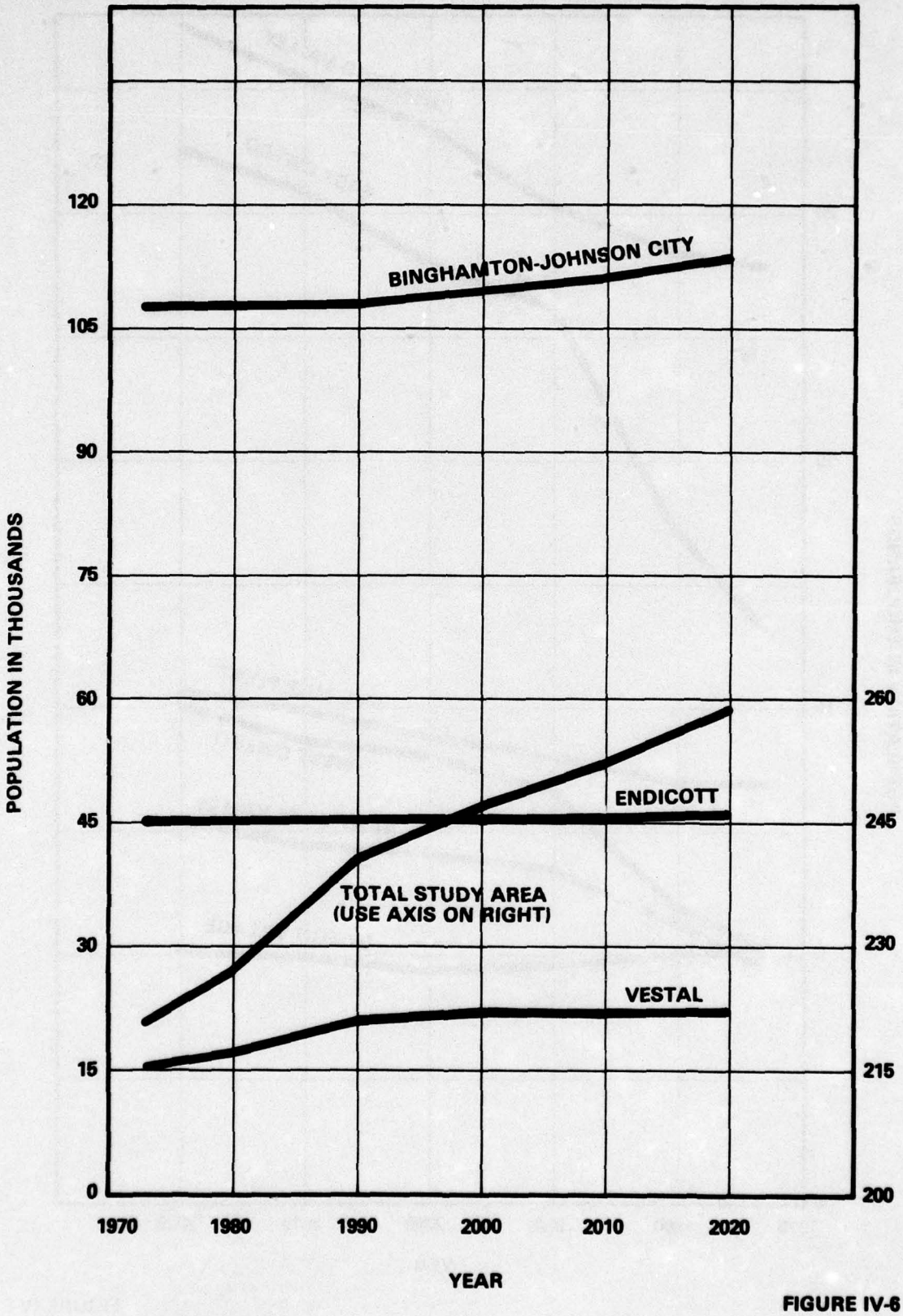


FIGURE IV-6

PROJECTED WASTEWATER FLOWS

In projecting future wastewater flows, the present per capita flow was used as a starting point. In the two largest wastewater management sewers, Binghamton-Johnson City, and Endicott, base per capita flows exclusive of infiltration/inflow (I/I) were used, and a constant I/I quantity (7.5 mgd for Binghamton-Johnson City and 0.7 for Endicott) was added to all projections. In presently non-sewered areas, a base residential per capita flow of 60 gpd was assumed; from an area of mixed residential, commercial, and industrial land use, 135 gpcd was assumed, based on Vestal and West Owego reported flows. Initially, a 10 percent increase per decade in per capita flows was used in the projections. This figure falls within the lower range of historical values of increased water consumption for comparable small urban areas (Table IV-10).

Flow projections for each wastewater management area were based on factors such as population and per capita flow forecasts, and on changes in land usage as indicated by the Southern Tier East Region General Plan (See Background Information Appendix). These initial projections are presented in Table IV-11 and the methodology for developing these projections is discussed below. In the flow projections, wastewater from Five Mile Point was added to Binghamton-Johnson City flows after 1977; Vestal (subareas V-2 and V-3) and Nanticoke Valley flows were added to Endicott after1977. These assumptions were based on current plans for expanding sewer services.

TABLE IV-10

INCREASES IN PER CAPITA WATER CONSUMPTION - SMALL URBAN AREAS

City	Per Capita Water Consumption (gpcd)			Rate of Increase (Percent)	
	1946	1956	1966	1946-56	1956-66
Springfield, Mass.	127	175	230	38	31
Lynchburg, Va.	95	114	134	20	18
Cedar Rapids, Iowa	91	136	170	49	25
Wichita, Kansas	117	146	148	25	1
Salem, Oregon	139	156	207	12	33

Source: Metcalf and Eddy, Wastewater Engineering, Chapter II, New York, McGraw Hill, 1972

TABLE IV-11

STAGE I - WASTEWATER FLOW PROJECTONS[1]
(Million gallons per day)

Wastewater Management Area & Service Area [2]	1973 [3]	1980	2000	2020	Current Plant Flow
Broome County					
Binghamton-Johnson City	19.9	21.1	24.2	28.5	18.3
Five Mile Point	0.7	0.8	1.4	1.9	-
Total Service Area		21.9	25.6	30.4	
Endicott	4.3	4.4	5.3	6.3	4.3
Vestal	1.9	2.3	3.6	4.5	1.0
Nanticoke Valley	0.3	0.4	0.5	0.7	-
Total Service Area		7.1	9.4	11.5	
Chenango Valley	1.6	1.7	2.3	3.1	-
Tioga County					
East Owego	0.7	1.2	2.6	3.6	0.4
West Owego	0.5	0.6	1.3	1.9	0.2
Owego Village	0.7	0.7	0.8	1.1	0.9

[1] Initial Study Projections
Flows based on 10% increase per decade in per capita wastewater produced.

[2] Service areas based on current regional plans by 1977.

[3] Includes presently unsewered areas.

Binghamton-Johnson City: The current per capita flow of 115 gpcd was used for initial conditions and inc eased 10 percent per decade. In addition, a constant 7.5 mgd was added to all projections to allow for inflow/infiltration.

Vestal: A base flow fo 135 gpcd (mixed industrial, commerical, and residential) and 60 gpcd (residential) were used for sub-municipal areas V-3 and V-2, respectively, and increased 10 percent per decade. Vestal flows were added to Endicott.

East Owego: It was assumed that areas OT-2 and OT-9 would shift from residential use to mixed use by the year 2000. Area OT-1 was projected to remain residential. Initial per capita flows of 60 gpcd (residential) and 135 gpcd (mixed use) were increased 10 percent per decade.

West Owego: It was assumed area OT-4 would remain residential (60 gpcd initially) and OT-5 will remain mixed use (135 gpcd initially). Area OT-3 was projected to shift from residential to mixed use by the year 2020. Per capita flows were increased 10 percent per decade.

Owego Village: The current per capita flow of 135 gpcd was increased 10 percent per decade.

Nanticoke Valley: Residential land use was assumed throughout the planning period. The initial per capita flow of 60 gpcd was increased 10 percent per decade. These flows were added to Endicott.

Chenango Valley: Areas CH-2 and F-2 were projected to remain residential. Areas CH-3 and F-1 were anticipated to have land usage intermediate between residential and completely mixed extremes. (Average of 60 and 135 gpcd, or 98 gpcd, to be increased 10 percent per decade.)

Five Mile Point: Areas C-2 and K-5 were expected to remain residential and K-4 and C-1 are expected to reach a completely mixed land usage by the year 2000 with an intermediate flow based on 98 gpcd in 1980. Five Mile Point flows were added to Binghamton-Johnson City projections.

The quality characteristics of the future wastewater flows were assumed to be much the same as present conditions, as the nature of the area's economy was not expected to change significantly. The projections assumed that residential, commercial, industrial, and institutional flows would maintain approximately the same proportions of the total wastewater produced. However, with pretreatment, cost recovery, and user charge requiirements imposed on industrial discharges, as required by P.L. 92-500, industries may elect to provide their own treatment. If this does occur, both the volumes and quality characteristics of wastewater requiring municipal treatment would change. The degree or nature of these changes are unpredictable, but may in general result in reduced flows of somewhat higher strength waste, approaching the quality of domestic sanitary sewage.

PROJECTED WASTEWATER FLOWS WITH NONSTRUCTURAL MEASURES

Nonstructural measures for reducing wastewater flows can be effective management tools. The Study assumed that per capita flows would be maintained at their current levels throughout the planning period (2020) with the application of nonstructural measures, such as sewer service limitations, metering, pricing, sewer ordinances, public education, and water conservation devices. Table IV-12 shows the wastewater flow projections with implementation of nonstructural measures.

WASTEWATER MANAGEMENT COMPONENTS

TECHNICAL CRITERIA

Existing Stream Standards

The Susquehanna River and its tributaries in Broome and Tioga Counties has five basic water quality classifications (Table IV-13 and Figure IV-7). The main stem of the Susquehanna has A, B, and C classifications. The Chenango and Tioughnioga Rivers and Cayuta Creek are Class B waters. The main stems of major creeks such as Owego and Nanticoke are Class C trout waters and the remaining small streams, many of which are intermittent, have a D classification.

TABLE IV-12

STAGE I - REDUCED WASTEWATER FLOWS FOR NON-STRUCTURAL ALTERNATIVES[1]
(Million gallons per day)

Wastewater Management Area & Service Area[2]	1973[3]	1980	2000	2020	Current Plant Flow
Broome County					
Binghamton-Johnson City	19.9	19.9	20.1	20.	18.3
Five Mile Point	0.7	0.6	0.9	1.0	-
Total Service Area		20.5	21.0	21.5	
Endicott	4.3	4.2	4.2	4.2	4.3
Vestal	1.9	2.1	2.8	2.8	1.0
Nanticoke Valley	0.3	0.3	0.4	0.5	-
Total Service Area		6.6	7.4	7.5	
Chenango Valley	1.6	1.5	1.6	1.8	-
Tioga County					
East Owego	0.7	0.9	1.6	1.8	0.4
West Owego	0.5	0.4	0.6	0.7	0.2
Owego Village	0.7	0.7	0.6	0.7	0.9

[1] Initial Study projections
Constant per capita flow assumed (1973 level).

[2] Service areas based on current regional plans by 1977.

[3] Includes presently unsewered areas.

TABLE IV-13

NEW YORK STATE CLASSIFICATION OF SURFACE WATERS

Classification	Best Usage
A	Source of water supply for drinking, culinary or food processing purposes, and any other usages.
B	Primary contact recreation and any other uses except as a source of water supply for drinking, culinary, or food processing purposes.
C	Suitable for fishing and all other uses except as a source of water supply for drinking, culinary, or food processing purposes, and primary contact recreation.
D	These waters are suitable for secondary contact recreation, but due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery or stream bed conditions, the waters will not support the propagation of fish.

Water quality standards which apply to these classifications are specified in Table IV-14. These standards have been published by New York State pursuant to the Environmental Conservation Law, Sections 15-0313 and 17-0301. With the exception of coliforms, phenols, and radioactivity, standards for Classes A, B, and C are identical. Class B (recreation) waters have the most stringent coliform standards, while phenols and radioactivity requirements apply only to Class A (drinking water). Within the Broome and Tioga Counties area, the most stringent dissolved oxygen standards apply to trout classified waters.

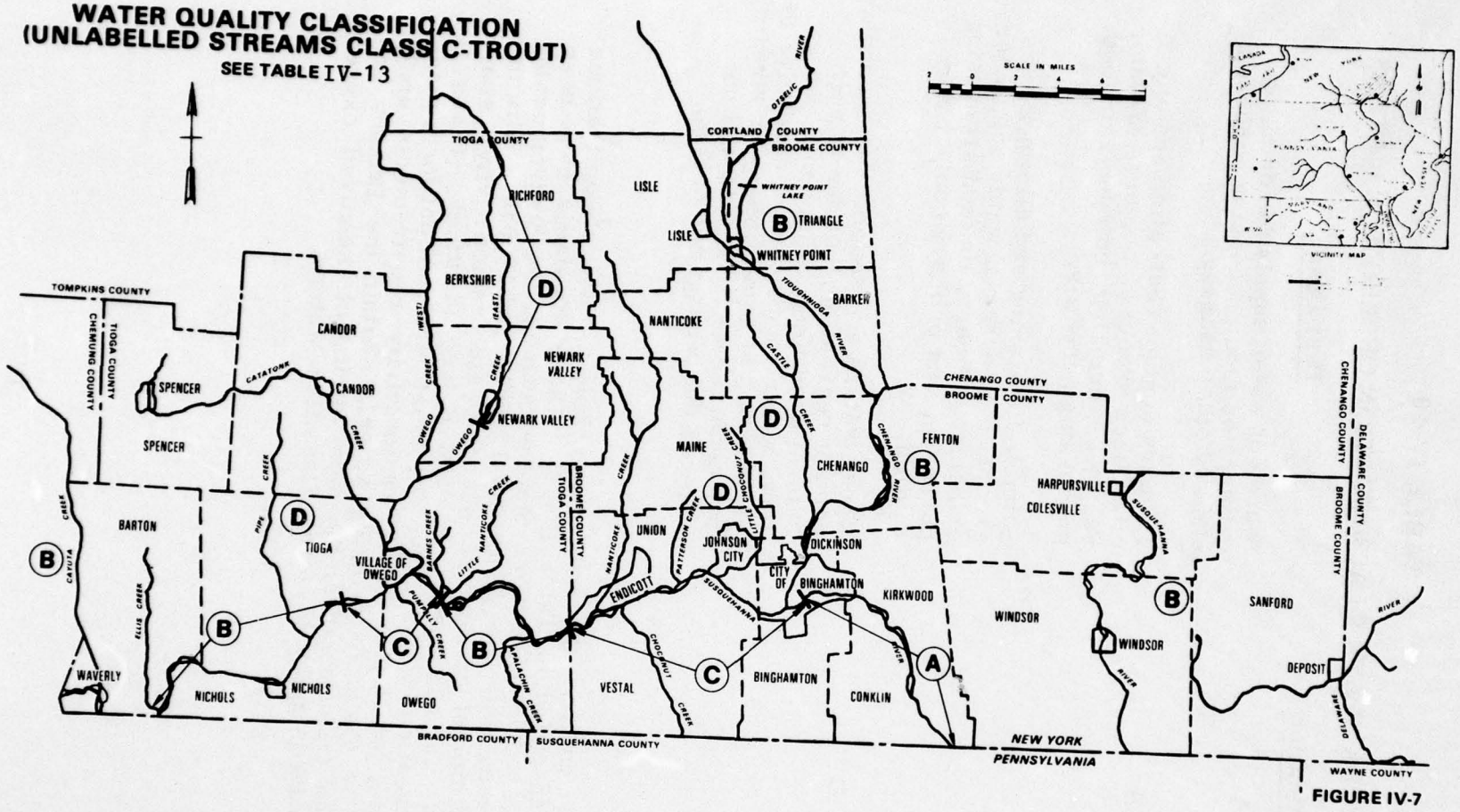

WATER QUALITY CLASSIFICATION
(UNLABELLED STREAMS CLASS C-TROUT)
SEE TABLE IV-13
SCALE IN MILES
VICINITY MAP
TIOGA COUNTY
CORTLAND COUNTY
BROOME COUNTY
TOMPKINS COUNTY
CHEMUNG COUNTY
CHENANGO COUNTY
DELAWARE COUNTY
BRADFORD COUNTY
SUSQUEHANNA COUNTY
WAYNE COUNTY
NEW YORK
PENNSYLVANIA
RICHFORD
LISLE
WHITNEY POINT
TRIANGLE
BERKSHIRE
NANTICOKE
BARKER
CANDOR
SPENCER
NEWARK VALLEY
MAINE
CHENANGO
FENTON
HARPURSVILLE
COLESVILLE
BARTON
TIOGA
VILLAGE OF OWEGO
UNION
JOHNSON CITY
DICKINSON
CITY OF BINGHAMTON
KIRKWOOD
WINDSOR
SANFORD
DEPOSIT
ENDICOTT
VESTAL
BINGHAMTON
CONKLIN
WAVERLY
NICHOLS
OWEGO
TIOUGHNIOGA RIVER
CHENANGO RIVER
SUSQUEHANNA RIVER
OWEGO CREEK
NANTICOKE CREEK
CASTLE CREEK
CHOCONUT CREEK
PATTERSON CREEK
TUTELLE CREEK
BARNES CREEK
LITTLE NANTICOKE CREEK
PUMPKIN HOLLOW CREEK
HALLOCHIN CREEK
PINE CREEK
CATATONK CREEK
CAYUTA CREEK
ELLIS CREEK
OSTERIC RIVER
WHITNEY POINT LAKE

FIGURE IV-7

TABLE IV-14

NEW YORK STATE WATER QUALITY STANDARDS

COLIFORM (#/100 ml)

1. Monthly median for minimum of five examinations - maximum value.

2. Maximum value for 80% of samples.

3. Monthly geometric mean fecal coliform from minimum of five examinations - maximum value.

	Class			
	A	B	C	D
1. Median:	5,000	2,400	10,000	-
2. 80%:	20,000	5,000	-	-
3. Fecal:	200	200	2,000	-

DISSOLVED OXYGEN

For cold waters suitable for trout spawning, the DO concentration shall not be less than 7.0 mg/l from other than natural conditions. For trout waters, the minimum daily average shall not be less than 6.0 mg/l. At no time shall the DO concentration be less than 5.0 mg/l. For non-trout waters, the minimum daily average shall not be less than 5.0 mg/l. At no time shall the DO concentration be less than 4.0 mg/l. For class D waters DO shall not be less than 3 mg/l at any time.

pH

Class A, B, C:	6.5 - 8.5
Class D:	6.0 - 9.5

TOTAL DISSOLVED SOLIDS

The maximum level for A, B, and C waters is 500 mg/l.

TABLE IV-14 (Continued)

PHENOLIC COMPOUNDS (Class A, only)

Maximum value of 0.005 mg/l (Phenol).

RADIOACTIVITY (Class A, only)

a. Gross Beta - maximum of 1,000 picocuries per liter in absence of Sr^{90} and alpha emitters.

b. Radium 226 - maximum of 3 picocuries per liter.

c. Strontium 90 - maximum of 10 picocuries per liter.

TOXIC SUBSTANCES
(Applicable to all Classifications)

With reference to certain toxic substances affecting fishlife, the establishment of any single numberical standard for waters of New York State would be too restrictive. There are many waters, which because of poor buffering capacity and composition will require special study to determine safe concentrations of toxic substances. However, most of the non-trout waters near industrial areas in this state will have an alkalinity of 80 milligrams per liter or above. Without considering increased or decreased toxicity from possible combinations, the following may be considered as safe stream concentrations for certain substances to comply with the above standard for this type of water. Waters of lower alkalinity must be specifically considered since the toxic effect of most pollutants will be greatly increased.

Ammonia or Ammonia Compounds:	Maximum of 2 mg/l (NH at pH 8.0)
Cyanide:	Maximum of 0.1 mg/l CN
Ferro or Ferricyanide:	Maximum of 0.4 mg/l Fe(CN)
Copper:	Maximum of 0.2 mg/l
Zinc:	Maximum of 0.3 mg/l
Cadmium:	Maximum of 0.3 mg/l

The Corps of Engineers' Definition of the 1985 Goal

Because effluent limitations commensurate with the National goal of zero discharge by 1985 have not been established by the EPA, the Corps of Engineers' interpretation was used for planning purposes.

Several concepts guided the development of the Corps' definition of effluent limitations:

1. Stream assimilative capacity should not be used to provide the final degree of treatment. Elimination of the effects of point source pollution discharges and minimization of non-point source problems would eventually permit the stream to return to a non-degraded condition.

2. Recognizing that most substances are essential in certain quantities, double distillation-type treatment was ignored. Water of this type would be too pure to permit a balanced, indigenous population of fish, shellfish, and wildlife.

3. All water should be reserved for multiple use. The following water uses determined a list of constituents and the critical levels above which they become pollutants for:

   a. potable supply

   b. crop irrigation

   c. livestock watering

   d. full body contact recreation

   e. freshwater fish and wildlife habitat.

The most stringent level from among the five uses was chosen as the definition of the 1985 goal for each constituent.

Constituents that are harmful to the environment, even at trace levels, are presented in Table IV-15. These pollutants should be completely absent from water bodies.

TABLE IV-15

POLLUTANTS TO BE COMPLETELY ABSENT

Arsenic	Pesticides and other synthetic organics
Barium	Phenols
Boron	Selenium
Cadmium	Silver
Copper	Zinc
Cyanides	Mercury
Lead	

In addition, the following constituents in Table IV-16 are considered a potential environmental and hygenic risk such that their absence is desirable, although presence at natural background levels may be permissable based upon an environmental assessment.

TABLE IV-16

POLLUTANTS PERMISSIBLE ONLY AT NATURAL LEVELS

Antimony	Nickel
Beryllium	Thallium
Cobalt	Tin
Molybdenum	Titanium

In the absence of determining natural background levels for a particular watercourse the levels presented in Tables IV-17 and IV-18 are to be used in determining the maximum acceptable levels for design. These effluent levels may be altered on the basis of an environmental assessment of their impacts. The specified levels are upper bounds and not average values. The constituents in Tables IV-15, IV-16, and IV-17 comprise the minimum acceptable group that must be considered in systems design. Other constituents (see Table IV-18) should be considered as appropriate, depending upon characteristics of the region.

TABLE IV-17

DESIGN EFFLUENT LEVELS

Constituents	Effluent Level
Total Dissolved Solids	Less than 500 mg/l in "fresh" water.
Biochemical Oxygen Demand	BOD level less than 5 mg/l. BOD level equal to or less than dissolved oxygen.
Heat	The level of which assures protection and propagation of a balanced, indegenous population of shellfish, fish, and wildlife in or on the water into which discharge is made.
Color	Less than 15 color units.
Nitrogen as Nitrate -N and Nitrite -N	Less than 4 mg/l total.
Nitrogen as Ammonia -N	Less than 0.5 mg/l.
Phosphorus as Total P	Less than 50 micrograms/liter entering a lake; or 100 micrograms/liter entering a flowing stream.
Oils and Greases	Trace
Fecal Coliform Organisms	Less than 200/100 ml.
Suspended Solids	Less than 5 mg/l.
Dissolved Oxygen	Greater than 5 mg/l.

TABLE IV-18

ADDITIONAL DESIGN PARAMETERS

Constituent	Effluent Level
Virus	Inactivated, but present at trace levels.
Surfactants	Trace
Fecal Streptococci	Inactivated, but present at trace levels.
Tastes and Odors	None offensive
Flotables	None
Settleable Solids	Trace
Volatile Solids	Trace
Gamma Radiation	Trace
Alpha Radiation	Less than one pico curie/liter.
Beta Radiation	Less than 100 pico curie/liter.
Turbidity	Less than five Jackson units.
Chemical Oxygen Demand	Less than 10 mg/l.
pH	Between 6.0 and 8.5.
Alkalinity	Less than 100 to 130 mg/l when pH is between 6.0 and 7.0.
Carbon Dioxide	Less than 25 mg/l.
Sulfates	Less than 100 mg/l.
Calcium	Less than 30 mg/l.
Chlorides	Less than 250 mg/l.
Sodium	Less than 10 mg/l.
Magnesium	Less than 125 mg/l.

TABLE IV-18 (Continued)

Constituent	Effluent Level
Fluorides	Varies from 1.7 mg/l at 10 degrees C to .8 mg/l at 30 degrees C.
Aluminum	Less than 1 mg/l.
Bicarbonates	Less than plus or minus 50 mg/l variation over ambient concentrations.
Manganese	Less than 0.05 mg/l.

The advanced waste treatment systems designed for the Binghamton Wastewater Management Study would meet or approach most of these criteria for the National goal.

Dissolved Oxygen Model for Susquehanna River

Recent water quality data (see section on existing water quality conditions in Background Information Appendix) may not be indicative of conditions during low flow periods due to higher than average river flows in recent years. Also, data taken prior to 1972-73 is no longer representative of current stream quality conditions because of the construction of four secondary treatment plants during that time. In particular, the existing data is insufficient to determine if water quality standards would be violated during critical low flow conditions with the present treatment systems. The minimum average seven day consecutive flow occurring in ten years (MA-7-CD-10) defines the critical low flows which New York State uses in its basin planning and permit program. Consequently, to predict Susquehanna River water quality during low flows, a mathematical model was considered necessary for planning purposes.

Since the present state-of-the-art limits accurate prediction primarily to dissolved oxygen (DO) concentrations, the remainder of this discussion is limited to this parameter. Of course, DO is traditionally the major water quality factor, particularly in areas such as Binghamton which is not characterized by major discharges of toxic contaminants. A

DO model was developed for the Susquehanna River by Quirk, Lawler, and Matusky Engineers, under contract with New York State Department of Environmental Conservation (NYSDEC). The model was validated through use of river sampling data and is currently being used by New York for basin planning and discharge permits.

The DO model uses the classical Streeter and Phelps equation. This equation has proven to be an accurate description of a stream's response to organic wastes and is readily adaptable for computer use. The basis of this equation is the assumption that the rate of deoxygenation, or depression of dissolved oxygen by biological activity, is proportional to the amount of organic material present; and the rate of reoxygenation, or taking into solution of atmospheric oxygen, is directly proportional to the existing oxygen deficit, or amount below oxygen saturation.

The assumption is made that over time, steady-state conditions prevail, i.e., that conditions of flow, temperature, waste loads, and initial dissolved oxygen and BOD do not vary in time for a given period. This assumption is accounted for in the modeling by segmenting the river reaches appropriately at points of change in conditions, e.g., input waste loads, tributaries, etc.

It is important to note that two types of wastes influence dissolved oxygen depletion. In addition to the biochemical oxygen demand (BOD) exerted by organic wastes, nitrogen compounds such as ammonia, which exert an NOD, or nitrogenous oxygen demand, are of particular significance in the Binghamton area.

The model was used to determine Susquehanna River DO levels which would result from existing wastewater discharges during an MA-7-CD-10 flow. A minimum DO of between 4 and 5 mg/l was observed near the Broome-Tioga County line. With all wastewaters receiving secondary treatment, the minimum DO was increased, but remained less than 5 mg/l. Future DO levels were also predicted using the projected wastewater flows developed for the years 1980 and 2000. Two conditions were considered. The first assumed the very high NOD removal (effluent NOD = 10 mg/l) currently being achieved by the new Binghamton-Johnson City treatment plant. The second utilized a lower removal level (NOD = 50 mg/l) which is normally associated with secondary treatment plants. The results are summarized in Table IV-19.

TABLE IV-19

STAGE I
PREDICTED MINIMUM DISSOLVED OXYGEN LEVELS
AT LOW FLOWS[1]
Susquehanna River: Binghamton to Owego

	Minimum DO Level (mg/l)
Existing Discharges	4 - 5
Secondary Treatment	4 - 5
1980 Discharges	
High NOD Removal	4 - 5
Normal NOD Removal	3 - 4
2000 Discharges	
High NOD Removal	4 - 5
Normal NOD Removal	2 - 3

[1] Low flow defined as the MA-7-CD-10 minimum average seven day consecutive flow occurring once in ten years.

As evidenced by the modeling results, even under the best conditions for NOD removal, minimum DO levels will be less than 5.0 mg/l. Moreover, if the Binghamton-Johnson City plant cannot maintain its current exceptional NOD removal, water quality standards would be violated by 1980.

The results indicated in Table IV-19 do not include the effects of discharges from combined sewer overflows. Such discharges can lower the DO concentrations by several mg/l.

The results of the modeling indicated that current discharges from wastewater treatment plants would not result in DO levels below 4 mg/l. Depending on the performance of the Binghamton-Johnson City plant, future discharges may lower DO concentrations to below 4 mg/l. Regardless of plant performance, combined sewer overflows would depress DO concentrations to below 4 mg/l during certain storm periods.

Due to the complex nature of streams, an exact value of DO is difficult to predict. A BOD loading to a stream may travel several miles downstream and pass through several

diurnal temperature variations before exerting its full oxygen demand. Variations in river flow, temperature, the amount of oxygen consuming pollutants, channel geometry, and algal activity all influence the precise prediction of dissolved oxygen concentration. The stream model, therefore, has certain limitations but it is useful as a planning tool to aid decision making. The New York State Department of Environmental Conservation uses this model in determing waste load allocations and certification of EPA permits for the National Pollutant Discharge Elimination System.

The model's predictions are based on (1) average effluent loadings from sewage treatment plants, (2) critical temperatures (26 degrees C) and (3) critical low river flows (MA-7-CD-10).

The model does not include the effects of photosynthesis or respiration on DO. Because of these two variable conditions, DO values cannot be precisely predicted. The model predicts neither the minimum daily or minimum daily average value, but rather, a value somewhere between the two standards. If the assumption is made that the model determines the minimum daily average DO, then only those strategies with a predicted value greater than 5 mg/l would be further considered. If the model is assumed to predict the minimum daily value, strategies with a DO concentration between 4 and 5 mg/l would also be further evaluated. The NYSDEC requested that no strategy be eliminated solely based on a predicted DO value between 4 and 5 mg/l.

Therefore, because of the uncertainty of interpreting the model and to prevent foreclosing future possibilities, wastewater management plans were carried forward that reflected both assumptions (i.e., some of the systems developed would maintain a predicted DO concentration of 4 to 5 mg/l; some would result in a DO concentration greater than 5 mg/l; and in the case of advanced waste treatment, a DO greater than 6 mg/l would be maintained).

DEVELOPMENT OF SYSTEM COMPONENTS

The technical systems developed in this Stage were based on several components: level of wastewater treatment, degree of regionalization, wastewater flow reduction methods, stormwater control, sludge management and time phasing of

the physical elements within a given system. The array of technical components considered during the Study are outlined in Table IV-20.

Control of wastewater within any management area can be affected by a variety of methods. In general, these methods will serve to remove contaminants from the wastewater, reduce the volume or flow of wastewater, or control the environmental impact of treated discharges.

TABLE IV-20

SYSTEM COMPONENTS

TYPE OF WASTEWATER TREATMENT

Secondary
Improved Secondary: Secondary plus nitrification or filtration
Land Treatment
Physical/Chemical Advanced Waste Treatment
Biological Advanced Waste Treatment

DEGREE OF REGIONALIZATION (Number and Location of Sewage Treatment Plants)

1 plant (1+0)*:	Binghamton-Johnson City (two county regonalization)
1 plant (1+0):	Binghamton-Johnson City (B-JC) serving the Urban Study Area
2 plants (2+0):	B-JC, Endicott
3 plants (2+1):	B-JC, Endicott, East Owego
4 plants (2+2):	B-JC, Endicott, East Owego, West Owego
4 plants (3+1):	B-JC, Endicott, Chenango Valley, East Owego
5 plants (2+3):	B-JC, Endicott, East Owego, West Owego, Owego Village
5 plants (3+2):	B-JC, Endicott, Chenango Valley, East Owego, West Owego
6 plants (3+3):	B-JC, Endicott, Chenango Valley, East Owego, West Owego, Owego Village

FLOW REDUCTION MEASURES

Structural
Infiltration Control (2, 4, or 6 mgd reduction)
Non-Structural
Metering, water saving devices, land use zoning, pricing, public education, restrictions of sewer services, sewer ordinances

STORMWATER CONTROL OF COMBINED SEWER OVERFLOWS

Storage
Microstrainers
Dissolved air flotation
Modified biological treatment

*(1+0) refers to the number of plants in Broome County and the number in Tioga County, respectively.

TABLE IV-20 (Continued)

SLUDGE MANAGEMENT

Dewatering Processes
Thickening, Digestion, Vacuum Filtration, Drying Beds, Lagoons
Final Disposal
Landfill, Agricultural Use, Incineration, Composting with Solid Waste

TIME PHASING OF SYSTEM ELEMENTS

To Meet Federal Objectives
1977 - Secondary Treatment
1983 - Best Practical Waste Treatment Technology (improved secondary)
1985 - Zero Discharge of Pollutants (advanced waste treatment)

To Maintain Stream Standards
Components phased as needed to meet capacity and water quality requirements

Type of Wastewater Treatment

The treatment technologies considered in this stage and the average effluent characteristics for each are listed in Table IV-21. The selection of treatment processes within each technology were typical combinations, and were not necessarily the only possibilities. Effluent characteristics are subject to wide variability, and again, the average values reported in the Table represent typical values, which might be associated with well-operated and maintained treatment systems. In some cases, secondary plants in the Binghamton area are producing effluents of higher or lower quality than the tabulated averages. However, since the long-run performance of the existing treatment systems was not known, the use of typical quality levels can be justified as best estimates of future performance. A range of treatment processes covering a wide spectrum of technologies were considered for the Urban Study Area and are discussed below.

TABLE IV-21

ESTIMATED EFFLUENT CHARACTERISTICS FOR ALTERNATIVE TREATMENT TECHNOLOGIES (mg/l)

Treatment Technology	SS	BOD	COD	Phosphorus	Nitrogen	NOD
I. Biological						
Secondary	20-30	15-25	30-60	6-10	20	50-75*
Secondary + Nitrification	20	10	45	8	20	5
Advanced	1	2	10	1	2	5
II. Physical/Chemical						
Secondary	20	20	35	2	30	120
Improved Secondary	20	20	35	2	20	5
Advanced	1	2	10	1	2	5
III. Land Treatment (after secondary)	0	2	10	1	2	0

*Warm weather characteristics. 50 mg/l for activated sludge, 75 mg/l for trickling filter.

Sources: R. Smith, W. F. McMichael, "Cost and Performance Estimates for Tertiary Wastewater Treating Processes" Robert A. Tuft Water Research Center, Repl. #TWRC-9, June 1969.

R. Smith, "Costs of Wastewater Renovation" U.S. Environmental Protection Agency, Advanced Waste Treatment Research Laboratory, November 1971.

R. Smith, "Cost and Performance Estimates for Wastewater Treatment Process Trains" U.S. Environmental Protection Agency, Advanced Waste Treatment Research Laboratory, Memorandum, dated April 5, 1974.

R. P. Monti, P. T. Silberman, "Wastewater System Alternates, Parts I, II, III, and IV" Water and Waste Engineering, March, April, May, June, 1974.

G. L. Culp, C. L. Hamann, "Advanced Waste Treatment Process Selection, Part I, II, III" Public Works, March, April, May, 1974.

Conventional (Secondary) Treatment.

At present, the predominant method of treating municipal wastewater in the United States is biological secondary treatment which utilizes the bacteria found naturally in wastewaters. This process removes a large percentage (80-90) of the suspended solids and biochemical oxygen demand (BOD is a measure of the amount of oxygen consumed by bacteria in breaking down organic matter in water and can severely deplete oxygen in streams and lakes). Conventional secondary treatment is achieved by accelerating the natural decomposition of organic wastes by bacteria in either activated sludge units, trickling filters, or aerated lagoons.

Improved Secondary Treatment.

Increased suspended solids removal can be achieved by adding filtration after secondary treatment. With the addition of a nitrification step, up to 95 percent of the BOD and NOD can be removed. (Nitrogenous Oxygen Demand is a measure of the amount of oxygen consumed by bacteria in breaking down nitrogen compounds such as ammonia.)

Biological Advanced Waste Treatment (AWT).

Following secondary treatment and nitrification, denitrification would be employed to remove nitrogen from the water. Further treatment in an AWT system must, of necessity, be non-biological. With the addition of lime, iron, or aluminum salts in either the primary or secondary settling tanks, phosphorus can be removed in the settled sludge. The last two unit processes are filtration, to remove a high percentage of the remaining suspended solids, followed by carbon adsorption which polishes the effluent by removing refractory organics and color. After chlorination, this system can be considered an approach to the zero discharge goal of P. L. 92-500.

A schematic of these treatment processes is presented in Figure IV-8.

Physical/Chemical (P/C) Treatment.

Although physical and chemical (P/C) wastewater treatment methods have long been available, non-biological treatment of municipal wastes is rarely used. However, the processes of chemical addition, coagulation and settling, and filtration

BIOLOGICAL TREATMENT SYSTEMS

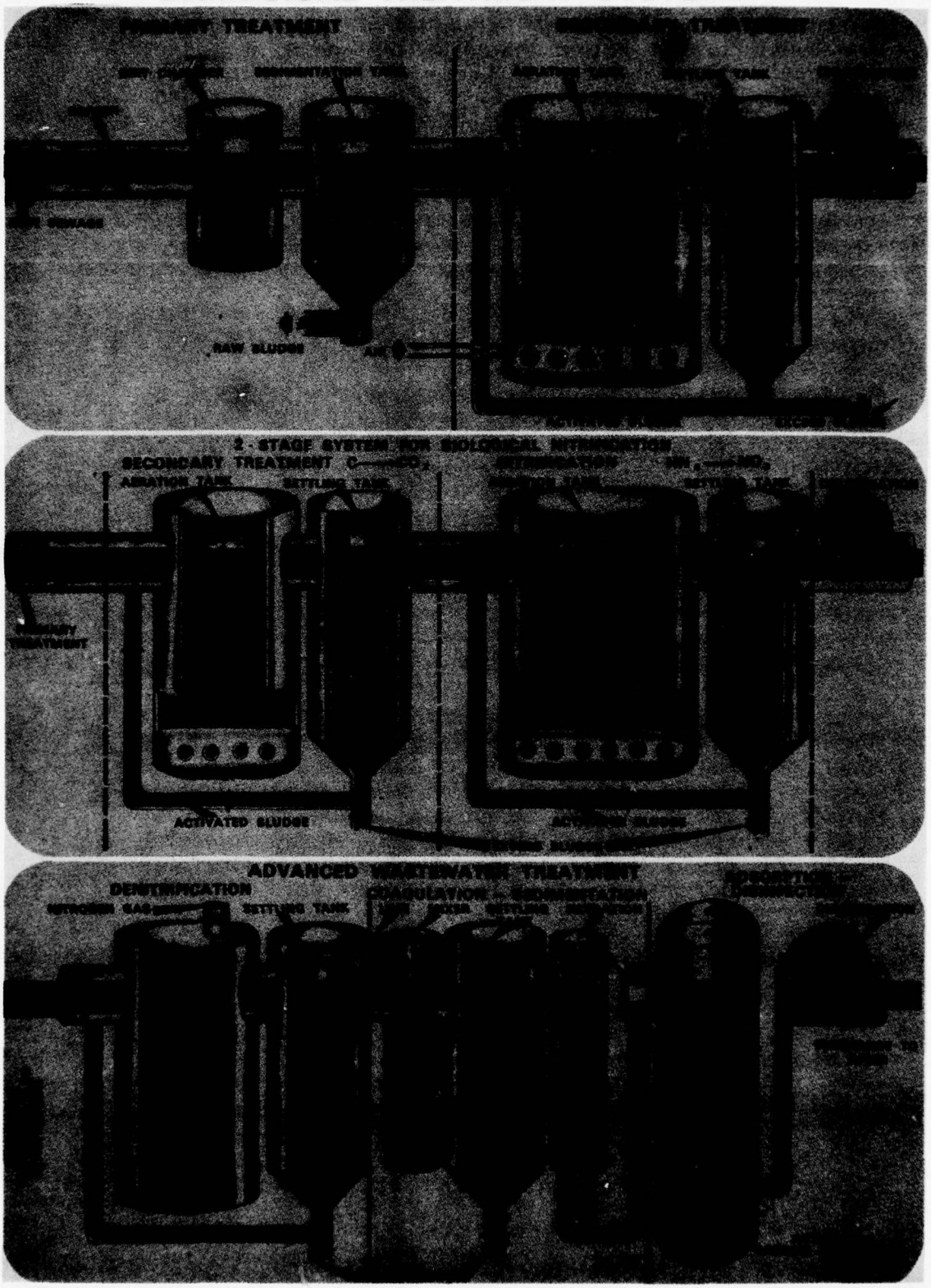


FIGURE IV-8

should produce an effluent with characteristics similar to secondary biological treatment with two exceptions: high levels of phosphorus removal can be achieved in secondary P/C systems but effluents will generally have higher ammonia levels than in biological systems. Chemical treatment requires more processes and produces greater sludge quantities than biological treatment at the secondary level. However, upgrading to advanced waste treatment is more straightforward in P/C systems since only two processes, breakpoint chlorination to remove ammonia and carbon adsorption must be added. Water quality achieved by either the P/C or biological advanced waste treatmet systems is similar. One type of physical/chemical treatment process is shown in Figure IV-9.

Land Treatment.

An alternative approach to meeting both the fishable-swimmable water quality objective and the zero discharge goal is land treatment of the effluent from secondary systems. The application of wastewater to soil covered by plants has seen wide use in various parts of the world for many years. Although land application has not been used extensively in the Northeast, a number of small U.S. cities and food processing industries dispose of wastewater by this means. Plant cover for disposal areas has included grass, forest, agricultural crops, and natural vegetation. After renovation by a combination of biological, chemical, and filtration processes within the plant/soil system, the wastewaters may enter surface waters or recharge groundwaters.

The basic approaches to land application include irrigation (spray, containment within borders, or ridge and furrow), overland flow, and rapid infiltration/percolation (Figure IV-10). The last of these methods uses large basins flooded with secondary effluent and is suited only for highly permeable soils and requires either a high level of pre-application treatment or large depths to the water table to prevent groundwater contamination. Overland flow is used with soils having very low infiltration capacity. Wastewater flows in sheet form over land planted with grass and is collected at the end of fields for further use or discharge. Spray irrigation is generally the most flexible and controllable application method, and is recommended in rugged terrain and forested areas.

PHYSICAL – CHEMICAL TREATMENT SYSTEMS

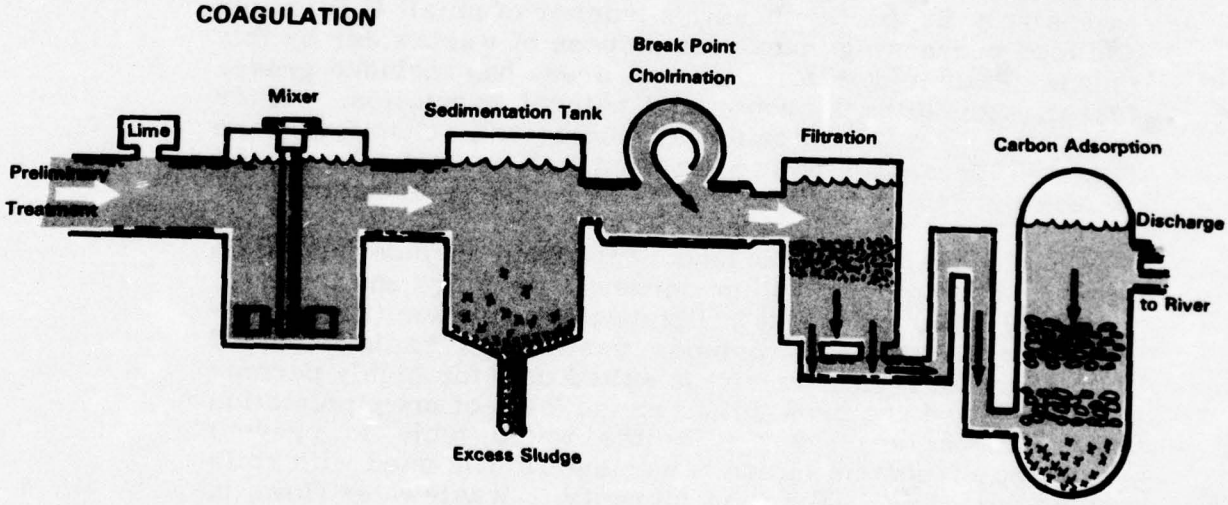
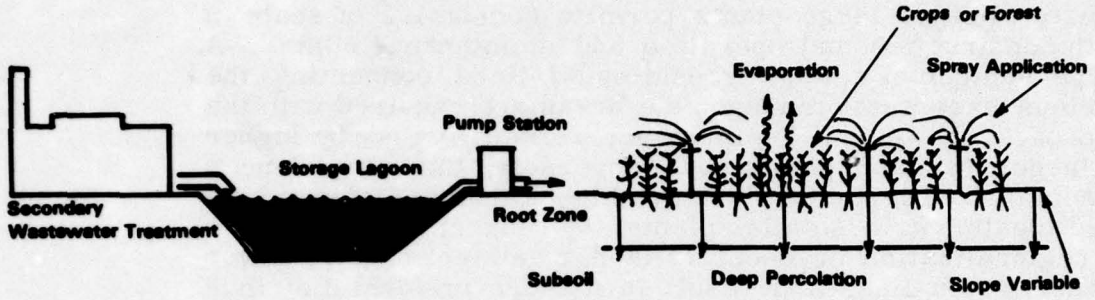


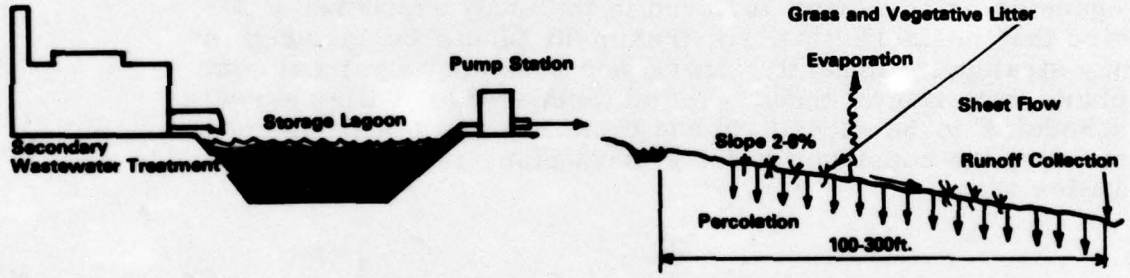
FIGURE IV-9

LAND TREATMENT SYSTEMS

IRRIGATION



OVERLAND FLOW



RAPID INFILTRATION

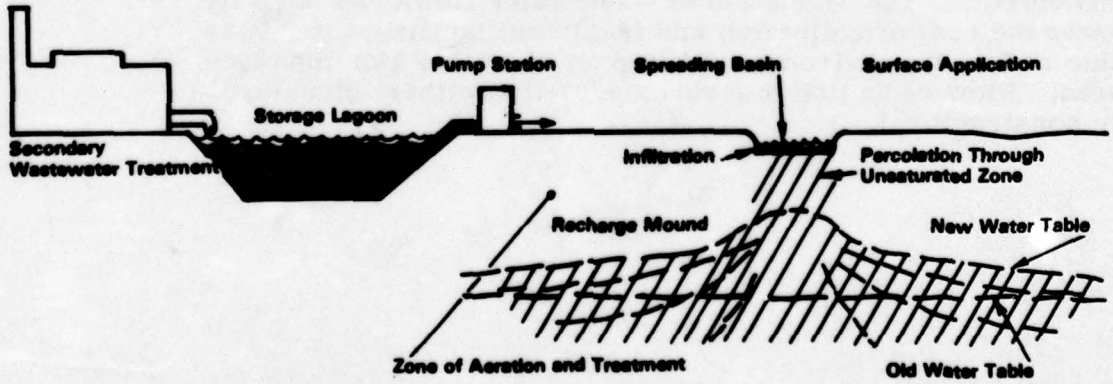


FIGURE IV- 10

Regionalization

Regionalization of wastewater collection and treatment refers to the number of distinct treatment systems which are included in any strategy. A high degree of regionalization may be characterized by complete treatment of the region's wastewaters in one or two municipal plants. The construction of large plants permits economies of scale in both construction and operation and maintenance costs. A large number of sewage transmission lines connecting the various wastewater management areas are required with the approach, however. Performance reliability may be higher in large, regional plants, but conversely, the consequences associated with plant failure are higher than with decentralized treatment in smaller plants. Moreover, lower degrees of regionalization or decentralized treatment require fewer transmission lines and result in a more uniform distribution of waste loadings to the area's waterways. Such distribution can result in more efficient utilization of stream waste assimilation capacity. The selection of a desirable degree of regionalization for wastewater management is seldom an obvious decision. Therefore, a variety of degrees have been included in the management strategies, ranging from one to six treatment systems for the study area. Agencies and citizens involved in the study expressed a desire that no more than six treatment plants be included in any strategy. Currently, there are seven sewage treatment plants with two of these (Vestal and Owego Valley View) scheduled to be closed. In addition, Broome County is considering the construction for a new plant in the Chenango Valley area.

Wastewater Flow Reduction Measures

This element of the wastewater management strategies is in many respects the most positive approach to water pollution abatement. The reduction of wastewater flows can not only lower the cost of collection and treatment facilities, but may also reduce the environmental impact of wastewater management. Flow reduction measures may be either structural or nonstructural.

Structural Measures.

The control of infiltration in sewerage systems is a structural means of reducing wastewater flows. Infiltration is a serious problem in the Binghamton and Owego Village sewer systems. Control measures would include rehabilitating combined sewers, overflow regulators, and manhole walls and regular inspection and cleaning of pipes.

Nonstructural Measures.

A program of six nonstructural wastewater reduction measures were investigated for the study area in Stage I.

Service Area Limitation. The economics of sewage collection typically control the extent to which non-urban areas become sewered, and such considerations may result in proposed service area limitations. However, even if the cost of sewering does not limit service areas, the costs of treatment and the environmental impacts of wastewater discharges to the Susquehanna River (as opposed to seepage to groundwaters from septic tank leaching fields) may provide adequate rationale for an active service limitation policy.

Sewer Ordinances. Well enforced regulations to prevent extraneous drainage water (from roofs, parking lots, underground drainage) from entering sanitary sewers can result in reduced wastewater volumes. Similarly, industrial cooling waters should not be discharged to sanitary sewers. Suggested sewer regulations have recently been published (Manual of Practice-Regulation of Sewers, 1973).

Water Metering A strong relationship between metering and reduced water consumption exists in the Binghamton area. Although metering is widespread in the urban region, it is not complete. Moreover, public buildings are often unmetered. Complete metering may tend to reduce water consumption and hence wastewater flows.

Pricing. Water districts typically bill on a flat rate for a maximum quantity of water consumption, and usage above this quantity is billed at a certain price per thousand gallons. This latter charge or incremental water rate influences water consumption, and increased incremental rates will

tend to decrease water use and wastewater flows. A more dramatic reduction could result if all water charges were based on quantity of water used. That is, no "free water" was included in the flat billing rate. The most rational billing procedure would utilize a water price based on the costs of both water supply provision and collection and treatment of wastewater. It should be noted that such pricing would be consistent with recent rulings by the General Accounting Office that advalorem taxes are not a proper means of levying user charges for wastewater collection and treatment systems.

Water Conservation. Residential water saving devices such as toilets, showers, and washing machines which minimize water usage can significantly reduce water consumption. For example, toilet flushing accounts for approximately 45 percent of household water use, and typical residential toilets range from 3 to more than 8 gallons of water per use. The total cost (including purchase, maintenance, and water charges) of household water applicances which conserve water does not differ significantly from non-conserving appliances (Howe, 1971).

Public Education. The success of any program for reduction of wastewater flows will depend on educational activities to convince the public of the program's value. In the Binghamton area, since water supply is both plentiful and inexpensive, public education must focus on the wastewater implications of water use. That is, the public must be made aware of the fact that water consumption influences wastewater management costs and the level of polluting discharges to surface waters.

It is difficult to estimate the effectiveness of the above flow reduction measures. In formulating a nonstructural wastewater management strategy, it was assumed that the program would at least maintain the current levels of per capita water use. In other words, the nonstructural measures would counteract the historical trend of a 10 percent increase per decade in per capita water consumption. It is possible, of course, for the program to result in reductions in per capita water use. However, since the effectiveness of reduction measures cannot be estimated with accuracy, the use of present per capita wastewater flows in projections provides a conservative approach.

With the exception of service area limitatons, the nonstructural measures will not in general reduce the total quantity

of pollutants in the wastewater. It is assumed that the treatment strategies outlined later in this section would be adequate to treat such wastewaters which would, in general, be similar to the current raw sewage produced in the area.

COST COMPONENTS

The costs which are presented in this report are capital, replacement, and operation and maintenance, all of which are expressed as either present worth or average annual costs. Capital costs include those expenditures for the initial construction of transmission and treatment works. Replacement costs of these items, following their useful life, were also calculated. Operation and maintenance costs include the projected yearly expenses to operate and maintain the physical system. Present worth and average annual costs are not actual costs per se but are used to compare the total costs of each alternative over the economic life of the project. The present worth of a system is the sum of the capital investments plus the present (1977) worth of all future costs, including operation, maintenance, and replacement costs, plus interest and amortization. The average annual cost is similar to the present worth except that the total costs throughout the economic life of the project are not projected back to the baseline year (1977) but rather, are expressed as an equivalent yearly cost. Again, present worth and average annual costs do not represent actual expenditures for any given year but are used solely to compare plans by expressing all costs on an equivalent basis.

PRELIMINARY STRATEGIES: STAGE I-2

INTRODUCTION

The development of wastewater management strategies for an urban area requires a careful consideration of the region's needs and problems, Federal and State regulations, and alternative technologies for water pollution control.

During Stage I of the study, general strategies covering a broad spectrum of management options for the Binghamton Metropolitan Area were developed. Emphasis was placed on providing a wide range of choice for the community with the only significant limitations being the elimination of systems of doubtful technical feasibility or those inconsistent with Federal and state law. Data were developed to the level of detail necessary to provide a comparison among strategies, but as the purpose of Stage I was to provide general strategies, no preliminary designs were included. Nor was any attempt made at detailed optimization of wastewater treatment processes.

Three iterations were accomplished in Stage I. As previously stated, the first iteration, the Plan of Study, developed the framework for the Study. Two subsequent iterations were performed providing the additional detail necessary in developing strategies.

Within Stage I, strategies were developed during two iterations. The second iteration formulated a wide range of technically plausible systems very broadly defined. No analyses of costs or impacts were made. Strategies in Iteration 3 were more fully described. Preliminary cost estimates and a determination of the resulting dissolved oxygen of the Susquehanna River were performed.

DESCRIPTION OF STRATEGIES

In this first formulation of preliminary strategies, four scales of regionalization were considered: individual service (one treatment plant for each service area), subregionalization, metropolitan regionalization (one plant for urban area), and complete bi-county regionalization (one plant for two county area). For all but the last, twelve different technical systems were initially considered for the nine management areas within the urban region. These methods are summarized in Table IV-22 and are discussed below.

Treatment System 1 essentially constituted secondary treatment to meet the 1977 minimum requirement for treatment of municipal wastewaters.

TABLE IV-22

TREATMENT SYSTEMS FOR STAGE I-2 STRATEGIES

Component	TREATMENT SYSTEMS 1	2	3	4	5	6	7	8	9	10	11	12
Secondary	X	X	X	X	X	X	X	X	X	X	X	X
Infiltration/Inflow Control		X	X	X	X	X	X	X	X	X	X	X
Service Area Reduction			X		X	X	X	X	X	X	X	X
Improved Secondary			X		X	X	X			X	X	
Storage of Combined Sewer Overflows				X	X	X		X			X	X
Flow Augmentation						X						
Pricing							X				X	X
Zoning							X				X	X
Land Treatment								X	X			
Biological Advanced Waste Treatment											X	
Physical/Chemical Advanced Waste Treatment												X
Sewer Separation										X		
Reuse											X	X

Treatment System 2 added infiltration and inflow control to secondary treatment to reserve as much capacity as possible for sanitary flows.

Treatment System 3 was for improved secondary treatment by adding filtration and/or nitrification, and also incorporated the flow reduction measures of inflow/infiltration control and service area limitation in order to reduce required plant sizes.

Treatment System 4 placed emphasis on stormwater control rather than flow reduction or higher treatment levels. Storage would be provided for combined sewer overflows with gradual release and treatment at the Binghamton-Johnson City plant.

Treatment System 5 provided for improved secondary treatment, stormwater control by storage of combined sewer overflows, and flow reduction by infiltration control and reduced service area.

Treatment System 6 included the measures in Treatment System 5 with the addition of flow augmentation by using Whitney Point Dam and Lake. Treatment Systems 5 and 6 represented the upper limit of what could be called "conventional" approaches to water pollution control.

Treatment System 7 placed a maximum emphasis on flow reduction measures to limit the sizes of treatment systems. Nonstructural measures such as service area limitation, pricing, and zoning would be employed as well as the structural measures of inflow/infiltration control. Nitrification and/or filtration would be added for improved secondary treatment.

Treatment Systems 8 and 9 employed land treatment of secondary effluent as a means of achieving high levels of water quality. To reduce land requirements, infiltration control and service area limitation would be included. The two systems differ only in that number 8 provided for storage of combined sewer overflows.

Treatment System 10 considered an alternative method of water quality improvement by providing for separation of storm and sanitary sewers to eliminate combined sewer overflows and infiltration. Improved secondary treatment and service area limitation would also be employed.

Treatment Systems 11 and 12 represented the highest levels of technology currently available for wastewater renovation.

To limit size of treatment plants and to insure high quality discharges to waterways, flow reduction measures such as infiltration control, service area limitation, pricing, zoning, and storage of combined sewer overflows will be necessary. Since the effluent would be of high quality, reuse would be possible. In spite of the similarities in effluent quality, the two methods utilized completely different unit processes. Biological advanced waste treatment (No. 11) could be effected by additions and modifications to secondary biological treatment whereas physical/chemical advanced waste treatment (No. 12) would require construction of entirely new treatment plants.

The twelve technical levels at three degrees of regionalization (individual service area, sub-regionalization, and metropolitan regionalization) produced 36 strategies. In addition to these, Strategy No. 37 combined Treatment System 3, improved secondary plus flow reduction measures, with complete bicounty regionalization. Such regionalzation would be reasonable only if economies of scale for treatment outweighed transmission costs and impacts. The evaluation of one strategy provided the necessary comparison.

With the exception of the complete bicounty scheme, the above strategies were analyzed only for the nine urban wastewater management areas. Four technical approaches were considered for the communities outside the study area. The first of these options essentially represented the exist-situation in the communities, with the exception that existing septic tanks and leaching fields may need replacement or modification. Other systems considered were biological secondary, land treatment, and physical/chemical advanced waste treatment. Further information is presented in the Outlying Communities Chapter of the Specialty Appendix.

REFINED STRATEGIES: STAGE I-3

REFINEMENTS AND MODIFICATIONS

As a result of analyses and discussions with agencies and groups involved with the Study, certain strategies were dropped or modified. Flow augmentation by release of stored waters from Whitney Point Dam was dropped from further

consideration by the Interagency Study Management Group for two reasons: (1) the Environmental Protection Agency does not consider flow augmentation an acceptable means of meeting in-stream water quality requirements, and (2) the storage capacity of Whitney Point Lake could not sustain a continued release of water during several months when in-stream water quality was considered critical near Binghamton.

Control of wastewater flow through methods such as pricing, metering, zoning, and service area restrictions were combined into a single category of nonstructural flow reduction measures. Reuse was dropped as a specific management strategy. The Binghamton area has a large supply of high quality water and wastewater reuse is of limited attractiveness.

Formulation

Treatment Plant Capacity.

In developing strategies in Stage I to treat future wastewater flows, existing sewage treatment capacities at all plants were used as shown in Table IV-23.

TABLE IV-23

EXISTING TREATMENT PLANT CAPACITIES

Sewage Treatment Plant	Capacity, mgd
Binghamton-Johnson City	25
Endicott - Primary	12
Secondary	7.7
East Owego (Town #2)	2
West Owego (Town #1)	0.5
Owego Village (Primary only)	0.5

The 25 mgd capacity given for the Binghamton-Johnson City Sewage Treatment Plant (STP) was a preliminary estimate based on operating experience. As the capacity of this plant was critical to the design and costs of any wastewater management scheme, further analyses (see Design & Cost

Appendix) were made in later stages to determine the exact capacity for a number of parameters.

For this iteration, assumptions were made concerning the removal efficiency of this STP under future conditions. The predicted minimum Susquehanna River dissolved oxygen (DO) under existing discharge conditions was between 4 and 5 mg/l for dry weather flows. In determining this result, the very high level of ammonia removal currently achieved at the plant was used (effluent NOD approximately 10 mg/l). With future increases of sanitary wastewater flows, it was doubtful if the above removals could be maintained. Accordingly, an NOD effluent concentration of 50 mg/l, corresponding to a normally expected value for a well performing biological system, was used to evaluate strategies. Because river DO values are very sensitive to NOD, changes in ammonia removal or nitrification potential of the Binghamton-Johnson City STP would have an important effect on whether or not standards for water quality are involved.

Cost Methodology.

The costs did not include the present costs of debt service or current operation and maintenance (O & M). The figures were based on average national costs adjusted to December 1974. Treatment and interceptor expenses were included but not local collection sewers which would be equivalent for each strategy. The majority of the cost data were based on EPA publications. Estimates were made for each plant, providing additional capacities and treatment processes as necessary. Each interceptor was estimated separately, utilizing the most probable route from the wastewater management area to the appropriate treatment plant. Costs for interceptors were based on the construction of new pipes from the service area to the treatment plant. Excess capacity in the existing interceptors was not assumed because of the large infiltration flow in the Binghamton sewerage system.

Land Treatment.

Whereas costs and effluent characteristics of wastewater treatment plants can be estimated from generalized information and cost curves, comparable characteristics for land treatment systems are more site specific, depending on such factors as soil types, climate, topography, and groundwater conditions.

The soils of Broome and Tioga Counties can be categorized under two broad headings. The valley soils (combination of Chenango, Tioga, and Howard Soil Associations) are sufficiently level and well-drained to be suitable for land application. However, these soils overlie the major groundwater supplies for the region and water tables are close to the surface. Near the urban areas there is extensive residential and commercial development. The outlying valley areas constitute the region's best agricultural land. Although the valley soils are conducive to land application of wastewater, they are generally highly developed and the risk of contamination of water supplies and streams is significant.

Most of the two county area is covered by upland soils of the Lordstown, Mardin, and Volusia Associations. These soils are moderately to steeply sloped, shallow, and poorly drained due to a dense soil layer or fragipan close to the ground surface. The water table is within several feet of the surface for much of the year. Residential development is sparse and the groundwater has limited water supply use. Although the poor drainage, hilly nature, and high water table of the upland soils is not ideal for land treatment, they were considered as the best soils in the Bicounty Area for land application. Another consideration for land treatment systems is the region's climate. The average frost-free season is about 140 days. Since the freezing temperatures in combination with the poor drainage and hilly terrain would interfere with equipment operation and result in ponding and runoff, the period of application was limited to a maximum of six months (May through October).

The upland areas are generally forested or used for pasture and hay. Either forest or grass is a suitable plant cover for land treatment. An application rate of 1.7 inches per week over a 26 week period, based on nitrogen limitations, was used in estimating land requirements. This corresponds to the nitrogen uptake of forests and grass of 200 pounds/acre/year in order to prevent excess nitrogen from entering groundwater or streams.

Of the basic types of land treatment systems, spray irrigation was considered the most feasible due to the rolling terrain, poor drainage, and forested areas of the upland regions. Other modes of irrigation such as ridge and furrow or containment within borders were not considered practical due to level land requirements of these methods. Rapid infiltration basins were not selected because of the necessity for highly permeable soils. The overland runoff method was also not selected because the costs for this system were found to be significantly higher than for spray irrigation.

This method also requires uniform and slightly sloping (2-6%) land. (More discussion of the land application investigations can be found in Chapter V of the Special Appendix.)

Regionalization.

Study participants, most notably members of the Citizens Advisory Committee, recommended more consideration be given to those strategies corresponding closely with the existing system, i.e., use the existing new secondary plants to the fullest advantage. To make better use of existing facilities and provide a wider range of choice, the degrees of regionalization were expanded to five levels in the third iteration of Stage I: 6, 5, 4, 3, and 1 plant, respectively.

Six Plants. A new plant would be constructed in Chenango Valley; Five Mile Point wastewater would flow to Binghamton-Johnson City; Nanticoke Valley and Vestal flows to Endicott. East Owego, West Owego, and Owego Village would each continue to be serviced by their existing treatment plants.

Five Plants. Strategies involving five plants differed from those with six plants only in that Chenango Valley wastewater would be transported to the Binghamton-Johnson City plant.

Four Plants. These strategies differed from five plant schemes in that Owego Village flows would be sent to West Owego.

Three Plants. The Binghamton-Johnson City plant would, in addition to its present service area, include flows from Five Mile Point and Chenango Valley. The Endicott service area would be expanded to include Nanticoke Valley, Vestal, and East Owego. The West Owego plant would service Owego Village.

One Plant. All wastewater from the urban metropolitan area would be sent to an expanded Binghamton-Johnson City plant.

DESCRIPTION OF STRATEGIES

Regionalization, level of treatment, flow reduction, and time phasing of components were grouped into 25 basic wastewater management strategies. The strategies were necessarily general in nature to prevent foreclosing the many possible combinations of components. For example, a uniform level of treatment was applied to each plant for a given regional system. This is not necessarily the optimum condition, but it did satisfy the purposes of Stage I strategy delineation, namely the comparison of a wide range of technically feasible options. Schemes for flow reduction, stormwater control, and sludge management could be added to any of the strategies. In subsequent stages, wastewater management systems were more fully defined and varying levels of treatment applied to each plant.

The strategies were arranged in three groups with the exception of Strategy 1 which represented the 1977 Baseline Condition against which the other alternatives were compared. Numbers 2 through 14 provided for treatment of maximum wastewater flows for the year 2000, i.e., flows that could be anticipated with maximum sewering and anticipated increases in water usage (10 percent per decade increase in per capita flows). Numbers 15 through 19 were designed to evaluate wastewater reduction measures through structural and nonstructural means to prevent an increase in per capita water consumption. Costs of the flow reduction measures were not included as the source of infiltration was not identified at this time and as little information existed on the costs of nonstructural measures. The third group of strategies, Numbers 20 through 25, represented short term schemes, meeting only the treatment requirements for 1980 flows.

Strategy 1

The 1977 Baseline Condition represented essentially the existing conditions plus those proposed actions likely to be in effect by 1977, i.e., sewerage provided for Nanticoke Valley and Five Mile Point (but not Chenango Valley), closing down the Vestal and Owego Valley View sewage treatment plants (STP's), and upgrading the Owego Village plant to secondary.

Strategy 2

Included six STP's providing secondary treatment, the five existing facilities plus a new plant in Chenango Valley.

Strategy 3

Included six plants providing secondary treatment plus filtration as a possible means of achieving the 1983 requirement of fishable/swimmable waters.

Strategy 4

Was equivalent to Strategy 3 except that Chenango Valley wastewater was diverted to the Binghamton-Johnson City STP. The comparison indicated any relative advantages of a separate Chenango Valley STP.

Strategy 5

Utilized advanced waste treatment at six plants.

Strategies 6, 7, 8, 9

Four plant regionalization schemes. Treatment levels employed were secondary (No. 6), secondary plus filtration (No. 7), secondary plus nitrification (No. 8) to provide another means of achieving the 1983 goal and advanced waste treatment (No. 9).

Strategies 10, 11, 12

Applied secondary, secondary plus filtration, and advanced waste treatment, respectively, at three regional STP's: Binghamton-Johnson City, Endicott, and West Owego.

Strategy 13

Represented an alternative approach to advanced waste treatment by utilizing land treatment. During the winter season, discharges of secondary effluent would be directly the rivers but during summer months, secondary effluent would be applied to the land. Approximately 15 mgd of effluent from the Binghamton-Johnson City STP would be applied on 5,800 acres in the Osbourne Creek area in the Town of Fenton and 2.3 mgd from the West Owego STP effluent would be applied to 900 acres in the Hunt's Creek region of the Town of Nichols. The remaining effluent from the two plants plus that from Endicott would continue to be discharged to the river.

Strategy 14

Complete regionalization of the urban area with the expansion of the Binghamton-Johnson City plant to handle all of the metropolitan area wastewater by applying advanced waste treatment.

Strategies 15, 16, 17, 18, 19

Applied flow reduction measures for a four plant regionalization system and for comparison to Strategies 5, 6, and 7 (no flow reduction). Infiltration control in Binghamton sewers were assumed to reduce the flow by 5 mgd. Nonstructural methods incorporated throughout the study area were assumed to reduce flows by a total of 11 mgd. Strategies 15 and 16 employed infiltration control at Binghamton. Number 15 also provided infiltration in addition to secondary treatment. Strategies 17 and 18 included secondary with infiltration control for No. 17 and with nitrification for No. 18. Strategy 19 utilized both infiltration control and nonstructural measures in addition to secondary treatment plus filtration.

Strategies 20, 21, 22, 23, 24, 25

Short term strategies designed for 1980 wastewater flows only. Strategies 20, 21, and 25 included six plants providing secondary, secondary plus infiltration, and secondary plus non-structural methods, respectively. Strategies 22 and 23 applied secondary treatment and nonstructural measures at four plants. Strategy 22 assumed a normally expected NOD effluent of 50 mg/l at the Binghamton-Johnson City STP while Strategy 23 used the current NOD of 10 mg/l. Strategy 24 provided secondary plus nonstructural measures for the five existing STP's.

SELECTION OF STRATEGIES FOR FURTHER STUDY

The 25 strategies with their associated costs and DO impacts on the Susquehanna River are presented in Table IV-24. Strategies with a minimum dissolved oxygen concentration less than four were not acceptable as they would not meet the existing State standards by the year 2000. General strategies selected for further study in Stage II were Numbers 1 (Baseline), 2, 5, 8, 9, 12, 13, 14, 18, 19, 23, 24, and 25.

TABLE IV-24

COSTS AND DISSOLVED OXYGEN IMPACTS
STAGE I-3 STRATEGIES

No.	Strategy	Number of STP's	Capital Costs Millon $'s	O & M Million $'s/yr	Total Annual[6] Cost Million $'s/year	Minimum[3] DO mg/l
1	*1977 Baseline Condition[1]	5	6	0.4	0.8	2.2
2	*Secondary[1]	6	15	0.4	1.5	2.4
3	Secondary[1] + Filtration	6	19	0.8	2.2	3.1
4	Secondary[1] + Filtration	5	21	0.7	2.2	2.9
5	*Advanced Waste Treatment	6	54	3.9	8.0	6.1
6	Secondary[1]	4	17	0.4	1.6	2.2
7	Secondary[1] + Filtration	4	21	0.7	2.2	2.9
8	*Secondary + Nitrification	4	26	0.7	2.6	5.3
9	*Advanced[1] Waste Treatment	4	53	3.3	7.4	6.0
10	Secondary[1]	3	20	0.5	1.9	2.1

TABLE IV-24 (Continued)

No.	Strategy	Number of STP's	Capital Costs Million $'s	O & M Million $'s/yr	Total Annual[6] Costs Million $'s/year	Minimum[3] DO mg/l
11	Secondary + Filtration[1]	3	23	0.8	2.5	2.8
12	*Advanced Waste Treatment[1]	3	54	3.3	7.4	5.9
13	*Secondary + Seasonal Land Treatment[1]	3	39	1.3	4.1	4.0
14	*Advanced Waste Treatment[1]	1	60	3.3	7.7	5.9
15	Secondary + Infiltration Control[1,4]	4	15	0.3	1.4	2.7
16	Secondary + Filtration + Infiltration Control[1,4]	4	19	0.6	2.0	3.3
17	Secondary + Filtration + Non-Structural Measures[1,4]	4	12	0.4	1.2	3.8
18	*Secondary + Nitrification + Non-Structural Measures[1,4]	4	16	0.4	1.5	5.5

TABLE IV-24 (Continued)

No.	Strategy	Number of STP's	Capital Costs Million $'s	O & M Million $'s/yr	Total Annual[6] Costs Million $'s/year	Minimum[3] DO mg/l
19	*Secondary + Filtration + Infiltration Control + Non-Structural Measures[1,4]	4	9	0.3	0.9	5.0
20	Secondary [2]	6	9	0.2	0.8	3.3[5]
21	Secondary + Filtration[2]	6	12	0.5	1.4	3.8[5]
22	Secondary + Non-Structural Measures [2,4]	4	7	0.05	0.5	3.6
23	*Secondary + Non-Structural Measures [2,4]	4	7	0.05	0.5	4.5
24	*Secondary + Non-Structural Measures [2,4]	5	6	0.05	0.4	4.5
25	*Secondary + Non-Structural Measures [2,4]	6	6	0.8	0.4	4.5

*Recommended Strategies for further study.
1 Year 2000 maximum wastewater flows.
2 Based on year 1980 maximum wastewater flows.
3 Minimum Susquehanna River dissolved oxygen level for dry weather flows.
4 Does not include costs of flow reduction measures.
5 Assuming effluent NOD from B-JC STP = 10 mg/l rather than 50 mg/l.
6 50 years @ 6% interest.

SUMMARY OF PUBLIC INVOLVEMENT: STAGE I

Public input to the Binghamton Wastewater Management Study stemmed primarily from three groups: the Interagency Study Management Group (ISMG), the Citizens Advisory Committee (CAC), and a Technical Advisory Committee (TAC). These committees reviewed all pertinent segments of work and reports and provided valuable assistance to the Study. The management structure for the Study is shown in Figure IV-11.

INTERAGENCY STUDY MANAGEMENT GROUP

The ISMG was formed on 22 January 1974 to provide guidance and insure timely completion of the Study by coordinating Federal, State, and local agencies. Participants originally included in the ISMG were the Southern Tier East Regional Planning Board (STERPB), New York State Department of Environmental Conservation (NYSDEC), Environmental Protection Agency, Region II (EPA), and the Corps of Engineers. A subsequent invitation was extended to and accepted by the Susquehanna River Basin Commission (SRBC).

The EPA indicated this Study should produce an areawide plan comparable to EPA 208 planning for use in applying for Section 201 grants. It was determined that the Outlying Communities would be studied in lesser detail due to time and funding limitations and to prevent precluding these areas from being eligible later for Section 201 planning funds. The ISMG agreed the major focus would be on the Binghamton Metropolitan Area consisting of Binghamton, Johnson City, Endicott, Vestal, Village of Owego, Nanticoke Valley, Chenango Valley, and Five Mile Point.

CITIZENS ADVISORY COMMITTEE

The CAC was established to provide a primary vehicle for public involvement and input to the Study effort. Their

MANAGEMENT STRUCTURE FOR THE BINGHAMTON WASTEWATER MANAGEMENT STUDY

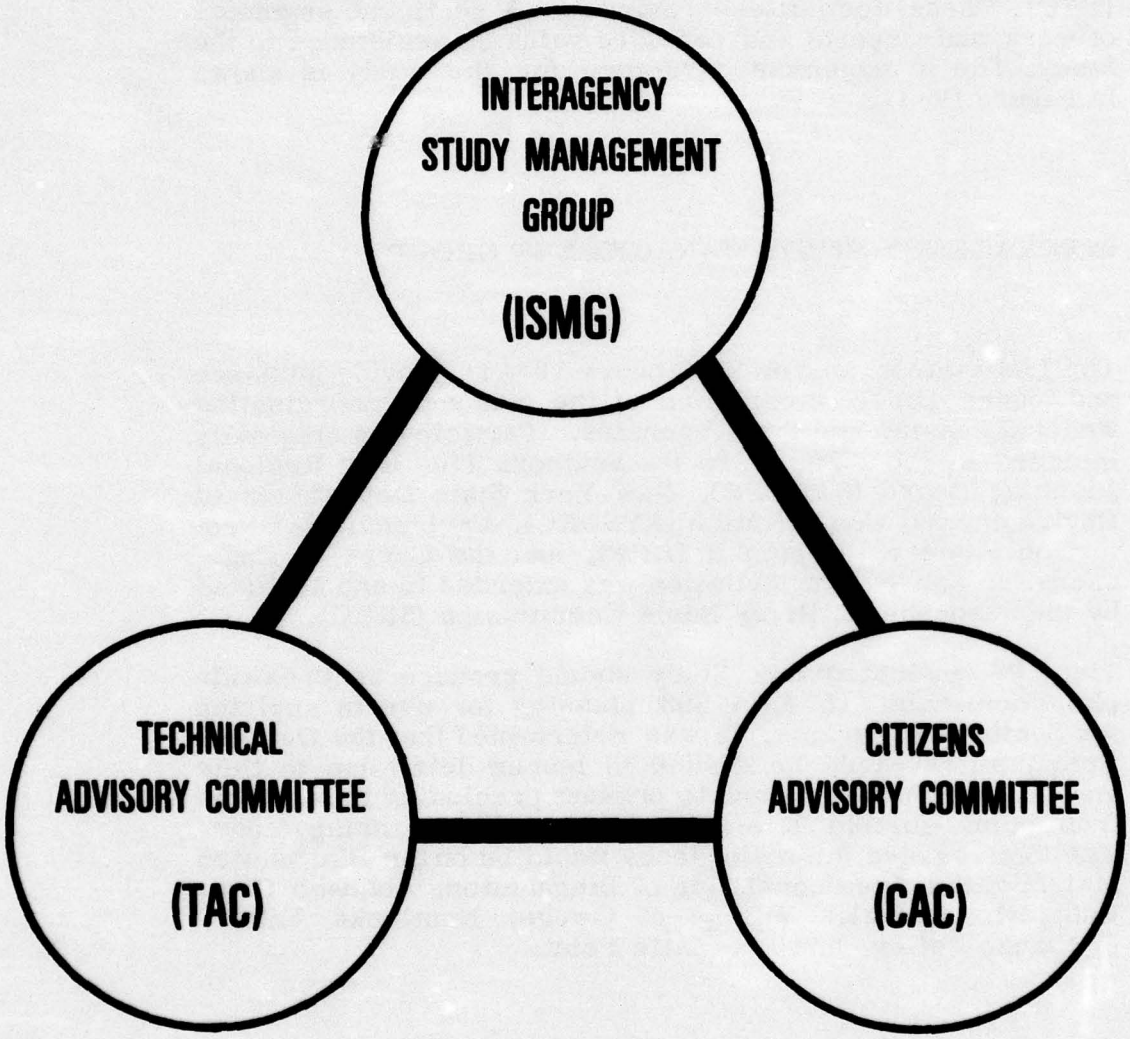


FIGURE IV-11

purpose was to assist the ISMG during plan formulation and evaluation of alternatives and to identify issues important to the region. Members were receptive to their suggested responsibilities as outlined in "Role of the Citizens Advisory Committee" described in the next section.

The CAC initially consisted of 20 members named by the STERPB director as citizens influential in water resources planning. As requested during CAC meetings and the first public meeting, membership was expanded to about 45 members. The attendance at meetings usually numbered about 20. The CAC decided to hold meetings on a regular basis throughout the Study in order to continuously evaluate study progress.

Role of the Citizens Advisory Committee

The Citizens Advisory Committee had an important role to play in the Binghamton Wastewater Management Study. The integration of the views of all concerned citizens was a vital component in producing an effective wastewater management program for Broome and Tioga Counties. Effective participation of all persons, however, could not be accomplished by relying solely on large public meetings; rather a selected group representing a wide range of viewpoints appeared to be an effective tool for communication with citizens at large. The Citizens Advisory Committee provided a channel of communication whereby concerned citizens were afforded the opportunity to make their views known and to obtain information relative to the Study. The responsibilities of the Citizens Advisory Committee included the following:

a. Identification of local objectives of the Study.

b. Reflection of the opinions of groups within the Study Area.

c. Offering of suggestions for Study direction.

d. Assistance to Interagency Study Management Group in determining the adequacy of alternatives under consideration.

e. Reviewing the ability of present institutional arrangements to implement various alternatives.

f. Attendance at regular meetings of the Citizens Advisory Committee.

g. Sharing of direction and sponsorship for public involvement program.

Table IV-25 indicates various categories of mechanisms and associated techniques of public involvement used during the Study, although not all were used in Stage I. As is apparent from the Table, various mechanisms were used depending on the nature of the information and the audience.

The most important task of the Citizens Advisory Committee, however, was to furnish the Interagency Study Management Group with a continuing evaluation of the Study as expressed by the views and preferences of citizens in Broome and Tioga Counties.

TABLE IV-25

PUBLIC INVOLVEMENT MECHANISMS

Information-Education	Interaction-Dialogue	Review-Reaction
Press Releases	Workshops	Public Meeting
News Conferences	Informal Contacts	Draft Reports
Brochures	Advisory Groups	
Newsletters	Interviews	
Speeches to Organized Groups	Study Group Discussion	
Reports		
Radio-TV Programs and Spot Announcements		
Briefings		
Films		
News Articles		

TECHNICAL ADVISORY COMMITTEE

To assist the ISMG, an informal Technical Advisory Committee (TAC) was set up to evaluate the technical engineering details of the study. Staff members from the ISMG agencies, as well as the City Engineer for Binghamton and the Broome

County Health Department, made up the representation of this group.

PUBLIC MEETING

To inform interested citizens in the Broome-Tioga County region of the commencement of the Binghamton Wastewater Management Study, the first public meeting was held in Binghamton on 19 March 1974. The procedure for a wastewater management study was presented and current treatment methods were outlined. A spokesman for Congressman Harold Robison delivered a statement indorsing the Corps' involvement in wastewater management planning in the Binghamton area. The EPA, NYSDEC, and STERPB each gave a brief description of their agency's involvement. The chairman of the CAC invited the audience to submit names of people who would be willing to serve on the CAC. Overall, the public expressed a general interest in the Study and its intended effort of maintaining good water quality in the Susquehanna River.

OTHER MEETINGS

In addition to the Corps' public involvement program, two meetings were held concerning the Study on 11 September 1974. A meeting sponsored by the Broome County Health Department and NYSDEC discussed various plans and problems associated with provisions of comprehensive sewage facilities for Broome County. It was stated the Corps' Study could be used to update or amend the present comprehensive plan for the Binghamton Metropolitan Area. Also on the same day, a workshop concerning the local significance of P.L. 92-500 was held by the Environmental Management Council (EMC) and the CAC.

CHAPTER V

STAGE II: FORMULATION OF ALTERNATIVES

INTRODUCTION

The first stage in plan formulation consisted of preliminary delineations of a broad range of technological strategies. Stage II of the planning analysis formulated detailed technical alternatives and included an assessment of impacts and more refined cost estimates for those alternatives likely to accomplish the Study objectives. Within the second stage, two iterations for formulation of alternatives, impact assessment, and evaluation were accomplished. In the first iteration (Stage II-1), strategies from the previous Stage were formulated into more specifically detailed alternatives. Costs were identified based on published cost curves of national averages. Preliminary impacts were assessed based on seven impact categories. An evaluation of these costs and impacts was also performed. In Stage II-2, the alternatives carried forward from the previous iteration were modified and again refined to greater detail. Costs were based on specific study area factors and initial design of major capital works rather than on national averages. An impact assessment for each alternative was presented. Also in Stage II, stormwater and sludge management alternatives were formulated and assessed.

STAGE II - ITERATION 1

FORMULATION

Revisions and Modifications

A primary concern of the Citizens Advisory Committee and the agencies involved with the Study was that uniform treatment levels were imposed on all treatment plants for every strategy proposed in Stage I. Alternatives in Stage II were developed in sufficient detail to determine the most efficient treatment levels (meeting desired objectives at the least cost) for each plant. By varying the level of treatment at each sewage treatment plant, and by expanding the range of regionalization to include one to six plants, the strategies developed in Stage I were refined more specifically to 40 alternatives in Stage II-1.

A two plant system was added to allow an examination of a full range of regionalization schemes, from one to six plants. All flows were projected to the year 2020. In addition to secondary treatment, two higher levels of treatment were considered: improved secondary treatment necessary to achieve fishable/swimmable waters (Class B) and advanced waste treatment (AWT) to approach the 1985 zero discharge goal. Several variations of improved secondary treatment were included: secondary plus nitrification at all plants; secondary at all plants plus nitrification at the Binghamton-Johnson City and Endicott facilities; secondary plus nitrification at just the Binghamton-Johnson City plant; and land application of the Binghamton-Johnson City effluent. No strategies which provided just secondary plus filtration were presented as the resulting river dissolved oxygen (DO) levels would fall below 4 mg/l. Thus, except for the 1977 Baseline Condition, no alternatives were presented which would not achieve the water quality standard. As the minimum DO level predicted by the computer model had not been exactly defined at the time as either the minimum daily (State standard of 4 mg/l) or the minimum daily average (State standard of 5 mg/l), alternatives which achieved either 4 or 5 mg/l were carried forward. Also evaluated were alternatives providing advanced waste treatment to approach the 1985 zero discharge goal of P.L. 92-500.

Comparison of Strategies and Alternatives

Table V-1 presents a comparison of Stage II-1 alternatives with the recommended strategies from Stage I. The recommended strategies from Stage I-3 were more narrowly defined into 40 alternatives by varying treatment plant levels for a given scheme, expanding the degrees of regionalization and by breaking down the broad categories of land treatment, nonstructural measures, and infiltration control into several more specific systems.

Description of Alternatives

The alternatives developed for this iteration were grouped under 12 basic categories. Within each category, varying levels of treatment and flow reduction measures were identified to form 40 separate alternatives.

I. 1977 Baseline Conditions.

The 1977 Baseline Condition is essentially a no action alternative. The purpose of including this alternative was to provide a baseline condition to which the features of any of the "action" alternatives could be compared. This alternative provided a prediction of conditions which would occur if the physical systems for wastewater management existing in 1977 were to remain unchanged throughout the planning period (to year 2020) while population continued to grow as projected. Components of the Baseline Condition were the existing treatment plants of Binghamton-Johnson City, Endicott, Owego Village, and Town of Owego Sewage Treatment Plants No. 1 (West Owego) and No. 2 (East Owego). Also included were the following proposed projects expected to be completed by 1977: (1) construction of an interceptor to transport Vestal sewage to the Endicott plant for which funding has been approved; (2) upgrading of the primary plant at Owego Village to secondary treatment; (3) phasing out the Valley View plant in Owego Village with sewage being sent to the Village treatment plant; and (4) an interceptor to provide the services of the Endicott treatment plant to Choconut Center. Although no projects had yet been authorized, previous studies recommended transmission of Five Mile Point sewage to the BinghamtonJohnson City plant and Nanticoke Valley sewage to Endicott. As a practical matter, stream standards are so high in each of these areas that local treatment would be undesirable. Hence, both recommendations were also included.

TABLE V-1

RELATIONSHIP OF STRATEGIES TO ALTERNATIVES

Stage II-1 Alternatives [1/]	Stage I-3 Recommended Strategies	Addition or Modification
I. Baseline	1	No change.
II. Metro Regionalization		
(a) Nit - 2	-	Varied treatment levels applied.
(b) AWT	14	No change.
III. Two Plant		
(a) Nit	-	Two plant systems evaluated.
(b) Nit 1	-	"
(c) Filtration, Nit @ Endicott	-	"
(d) AWT	-	"
IV. Three Plant		
(a) Nit	-	Varied treatment levels applied.
(b) Nit - 2	-	"
(c) Nit - 1	-	"
(d) AWT	12	No change.
V. Four Plant		
(a) Nit	8	No change.
(b) Nit - 2	-	Varied treatment levels applied.
(c) Nit - 1	-	"
(d) AWT	9	No change.
VI. Five Plant		
(a) Nit	-	Varied treatment levels applied.
(b) Nit - 2	-	"
(c) Nit - 1	-	"
(d) AWT	-	"
VII. Six Plant		
(a) Nit	-	Varied treatment level applied.
(b) Nit - 2	-	"
(c) Nit - 1	2	Nitrification added.
(d) AWT	5	No change.

TABLE V-1 (Continued)

Stage II-1 Alternatives 1/	Stage I-3 Recommended Strategies	Addition or Modification
VIII. Bicounty Regionalization		
(a) Nit	-	One plant for total Bi-
(b) AWT	-	county area evaluated.
IX. Physical/Chemical (4 plants)		
(a) Nit	-	Physical/Chemical pro-
(b) AWT	-	cesses to replace bio- logical.
X. Land Treatment (4 plants)		
(a) 80% Year Round	-	Varied level of treat- ment applied.
(b) 80% Seasonal	13	Four plant system.
(c) 100% Seasonal	-	Varied level of treat- ment applied.
XI. Non-Structural (4 plants)		
(a) Nit	18	No change.
(b) Nit - 2	-	Varied level of treat- ment applied.
(c) Nit - 1	23, 24, 25	Nit added, long range alternative.
(d) AWT	-	Varied level of treat- ment applied.
XII. Infiltration Control (4 plants)		
(a) 2 mgd reduction + Nit	-	Varied level of treat- ment applied.
(b) 4 mgd reduction + Nit	-	"
(c) 4 mgd reduction + Non-struc.	19	Filtration dropped.
(d) Nit @ Endicott + (c)	-	Varied level of treat- ment applied.
(e) Nit - 2 + (c)	-	"
(f) AWT	-	"

1/ All treatment plants have minimum of secondary treatment. Technologies are biologically based except for Category IX alternatives. Nitrification (Nit), Advanced Waste Treatment (AWT) applied to all treatment plants except as noted: Nit - 1 denotes nitrification at the Binghamton-Johnson City plant only; Nit - 2 denotes nitrification at both the Binghamton-Johnson City and Endicott plants.

Because of the uncertainty surrounding the proposed plans for wastewater management in the Chenango Valley area, the 1977 Baseline Condition for the area included the continued use of septic tanks for sewage disposal throughout the planning period. At the Binghamton-Johnson City plant, no plans for expansion have been formulated and the present size plant was maintained throughout the planning period.

With this static physical condition, the population was assumed to grow at the same rate as with the "action" alternatives. Population growth was not assumed to be limited by the capacity of wastewater facilities even though these facilities, e.g., a treatment or septic system, might become overloaded. It was also assumed population growth within a given treatment plant service area would be served by that plant, even where physical extension of the collection system would be necessary.

The Baseline Condition alternative provided a future "no action" condition against which the impacts and costs of the "action" alternatives could be assessed. Thus, the Baseline Alternative resulted in deteriorating effluent and river water quality, increasing problems with septic tanks in the Chenango Valley and continued combined sewer overflow problems. However, costs to the citizens of Broome and Tioga Counties for the Baseline Condition would be less than any of the action alternatives.

II. Metropolitan Regionalization.

All existing operations would be discontinued except for the Binghamton-Johnson City plant which would be expanded to service all nine metropolitan wastewater management areas. Major transmission mains would be constructed throughout the urban areas as shown in Figure V-1.

III. Two Plant Regionalization.

Wastewater from the study area would flow to the two largest existing plants, Binghamton-Johnson City and Endicott, with both requiring expansion (major expansion for Endicott). Figure V-2 depicts the required interceptors and treatment plant locations.

SINGLE PLANT REGIONALIZATION

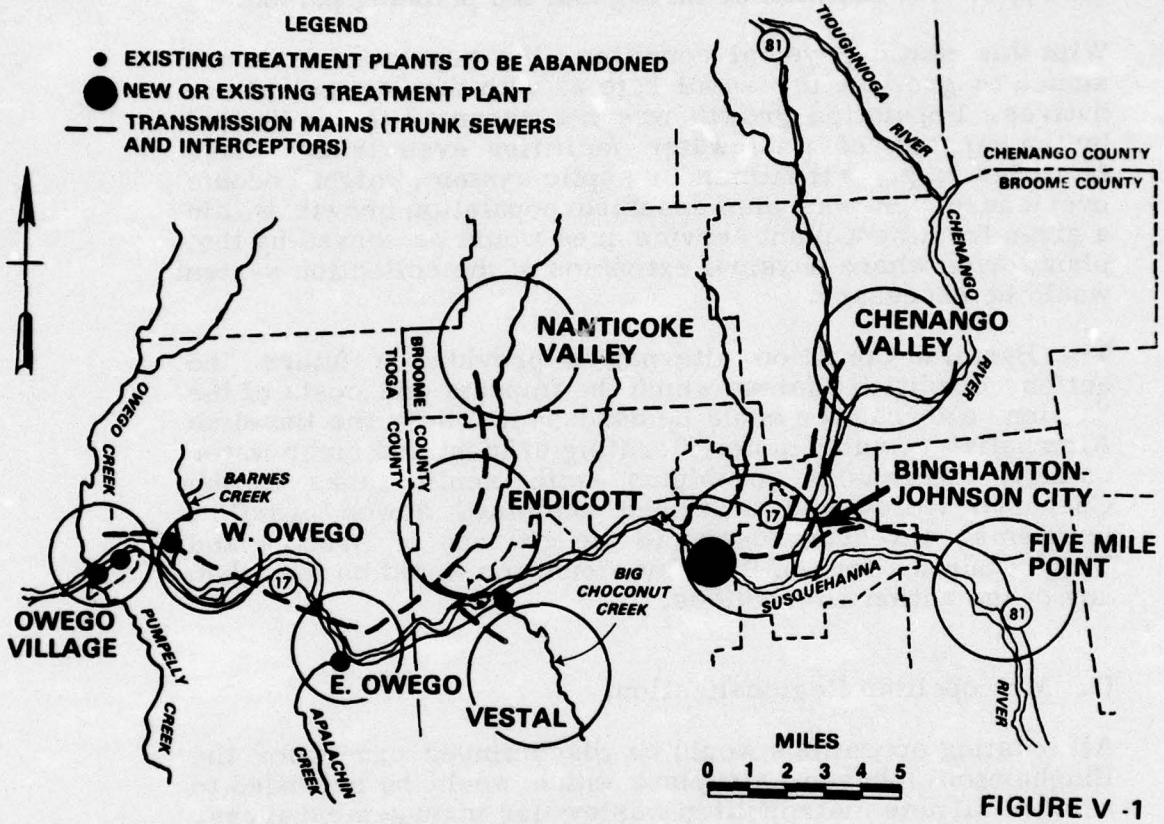


FIGURE V -1

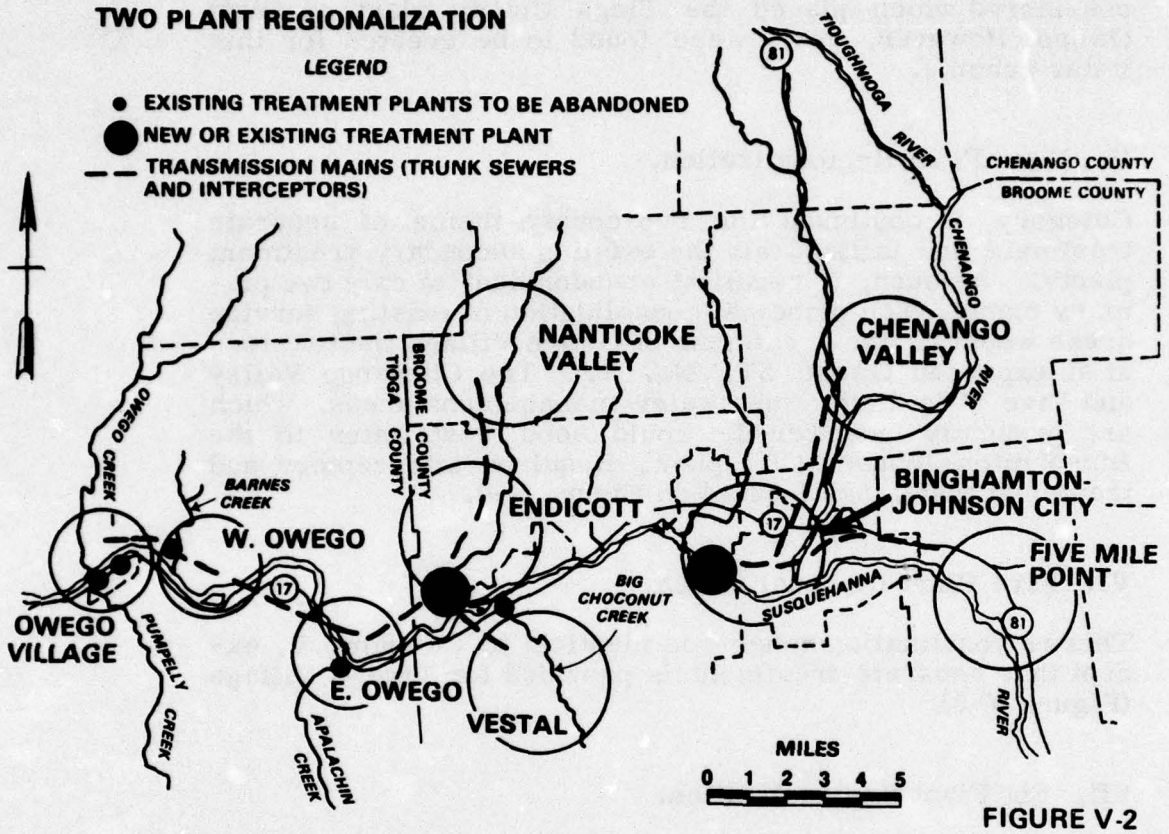

TWO PLANT REGIONALIZATION
LEGEND
EXISTING TREATMENT PLANTS TO BE ABANDONED
NEW OR EXISTING TREATMENT PLANT
TRANSMISSION MAINS (TRUNK SEWERS AND INTERCEPTORS)
TIOUGHNIOGA RIVER
CHENANGO COUNTY
BROOME COUNTY
CHENANGO RIVER
NANTICOKE VALLEY
CHENANGO VALLEY
BROOME COUNTY
TIOGA COUNTY
OWEGO CREEK
BARNES CREEK
W. OWEGO
ENDICOTT
BINGHAMTON-JOHNSON CITY
FIVE MILE POINT
OWEGO VILLAGE
PUMPELLY CREEK
BIG CHOCONUT CREEK
SUSQUEHANNA RIVER
E. OWEGO
VESTAL
APALACHIN CREEK
MILES
0 1 2 3 4 5

FIGURE V-2

IV. Three Plant Regionalization.

In this category, wastewaters from the two counties would be handled by separate treatment systems as shown in Figure V-3. Owego STP No. 2 (East Owego) would be expanded to treat sewage from the three Tioga County wastewater management areas. An alternative three-plant strategy was considered which placed the Tioga County plant at West Owego. However, costs were found to be greater for this latter scheme.

V. Four Plant Regionalization.

Category V continued the two-county theme of separate treatment and utilized all the existing secondary treatment plants. As such, it required abandonment of only two primary plants. The principal consolidation of existing service areas would be the treatment of Owego Village wastewaters at an expanded Owego STP No. 1. The Chenango Valley and Five Mile Point wastewater management areas, which are presently unsewered, would send wastewater to the Binghamton-Johnson City plant. Required interceptors and treatment plants are located on Figure V-4.

VI. Five Plant Regionalization.

This regionalization scheme is identical to Category V, except that separate treatment is provided for Owego Village (Figure V-5).

VII. Six Plant Regionalization.

The only completely new treatment plant proposed in any alternatives was provided in the six-plant regionalization scheme as shown in Figure V-6. The Chenango Valley wastewater management area would have its own STP. Comparison with the five-plant alternatives indicated whether or not the new plant was desirable.

VIII. Complete Bicounty Regionalization.

This system was included to investigate the economies of scale associated with treating all wastewater from the Urban Study Area as well as the Outlying Communities at one centralized location such as the Binghamton-Johnson City STP.

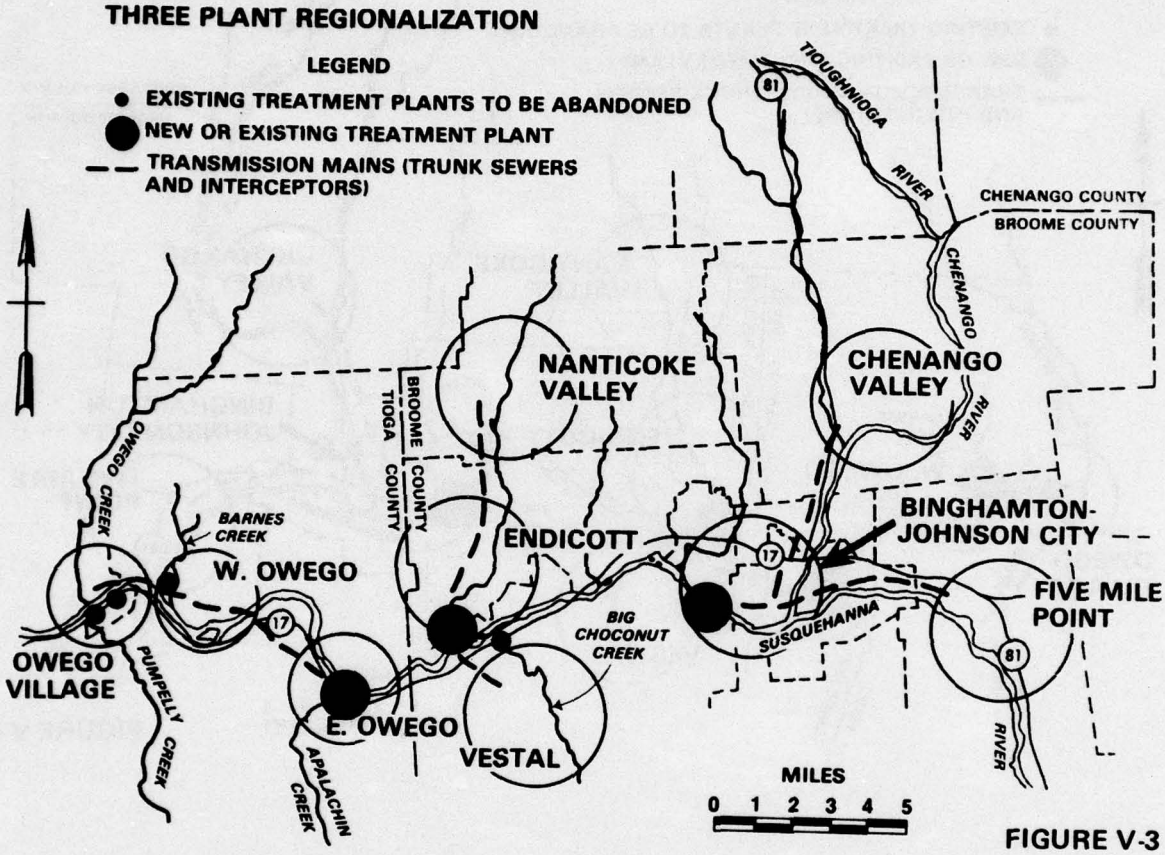

THREE PLANT REGIONALIZATION
LEGEND
EXISTING TREATMENT PLANTS TO BE ABANDONED
NEW OR EXISTING TREATMENT PLANT
TRANSMISSION MAINS (TRUNK SEWERS AND INTERCEPTORS)
TIOUGHNIOGA RIVER
81
CHENANGO COUNTY
BROOME COUNTY
CHENANGO RIVER
NANTICOKE VALLEY
CHENANGO VALLEY
BROOME TIOGA COUNTY
OWEGO CREEK
BARNES CREEK
W. OWEGO
ENDICOTT
17
BINGHAMTON-JOHNSON CITY
FIVE MILE POINT
BIG CHOCONUT CREEK
SUSQUEHANNA RIVER
OWEGO VILLAGE
PUMPELLY CREEK
E. OWEGO
VESTAL
APALACHIN CREEK
MILES
0 1 2 3 4 5

FIGURE V-3

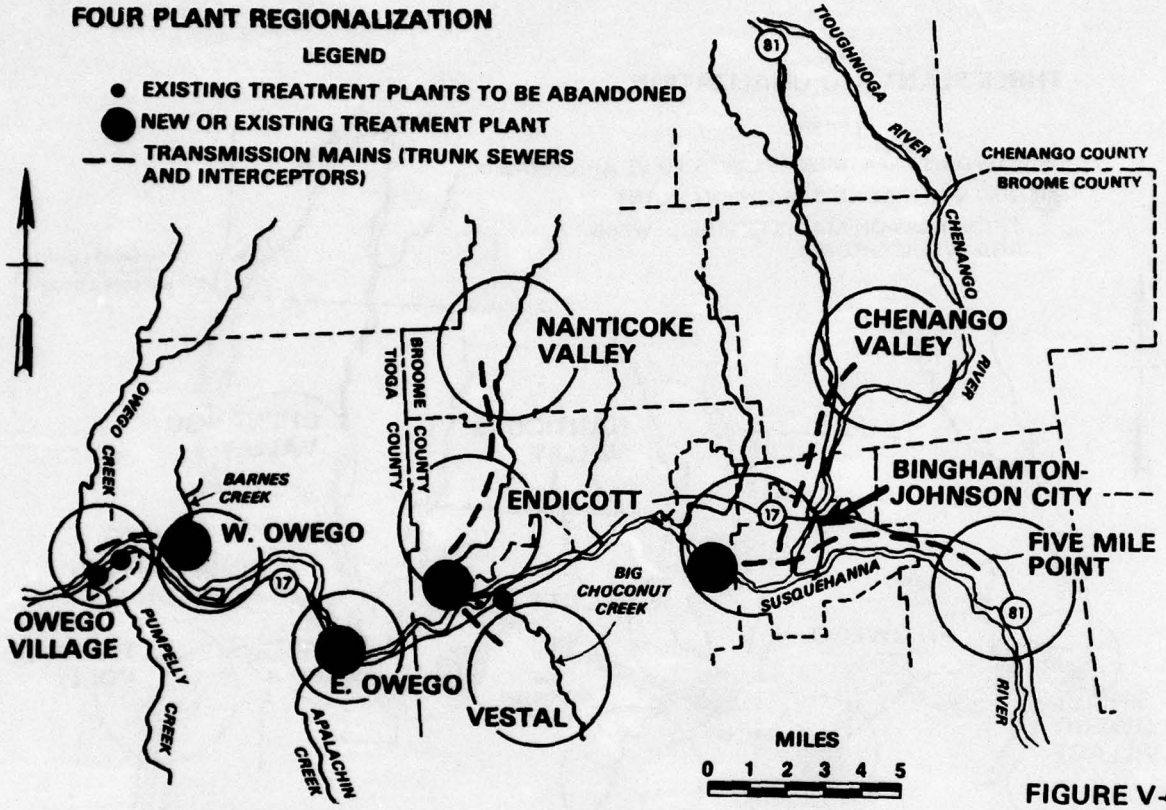

FOUR PLANT REGIONALIZATION
LEGEND
EXISTING TREATMENT PLANTS TO BE ABANDONED
NEW OR EXISTING TREATMENT PLANT
TRANSMISSION MAINS (TRUNK SEWERS AND INTERCEPTORS)
TIOUGHNIOGA RIVER
81
CHENANGO COUNTY
BROOME COUNTY
CHENANGO RIVER
NANTICOKE VALLEY
CHENANGO VALLEY
BROOME COUNTY
TIOGA COUNTY
OWEGO CREEK
BARNES CREEK
W. OWEGO
ENDICOTT
BINGHAMTON-JOHNSON CITY
17
FIVE MILE POINT
BIG CHOCONUT CREEK
SUSQUEHANNA RIVER
OWEGO VILLAGE
PUMPELLY CREEK
E. OWEGO
VESTAL
APALACHIN CREEK
MILES
0 1 2 3 4 5

FIGURE V-4

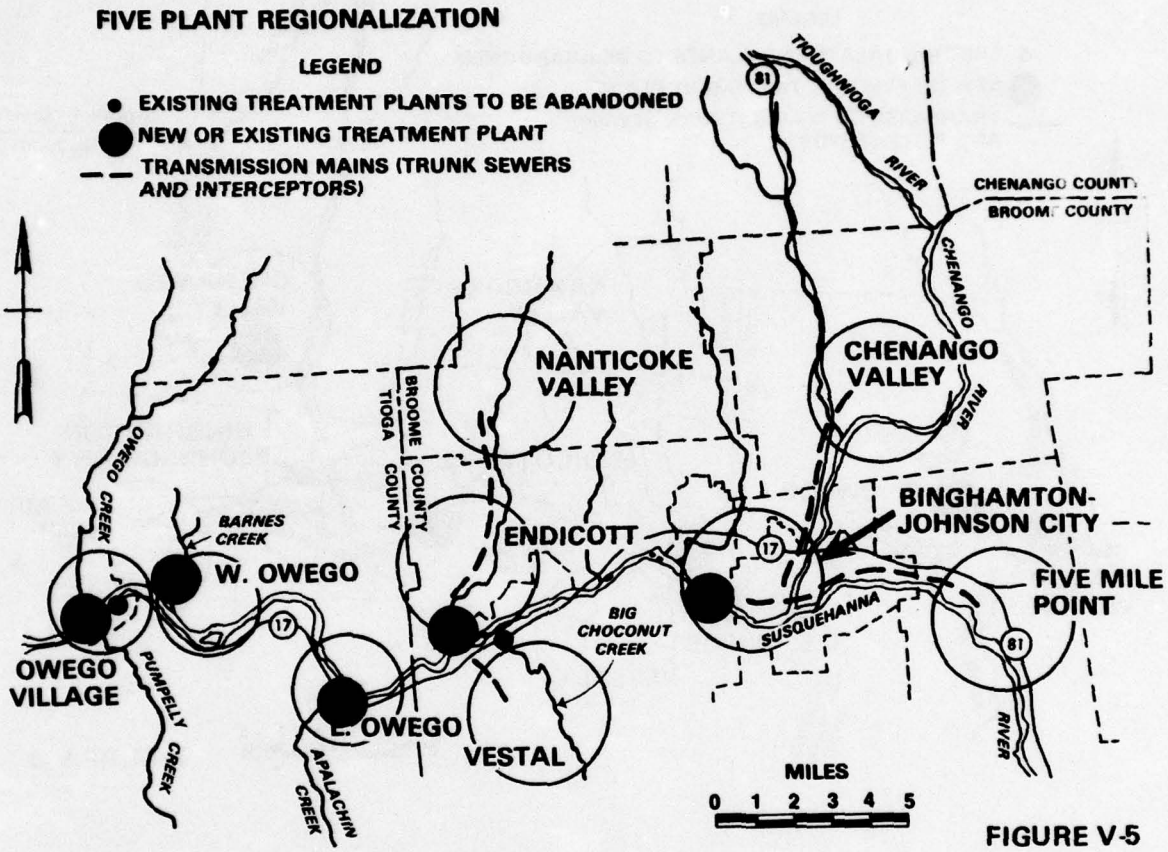

FIVE PLANT REGIONALIZATION
LEGEND
EXISTING TREATMENT PLANTS TO BE ABANDONED
NEW OR EXISTING TREATMENT PLANT
TRANSMISSION MAINS (TRUNK SEWERS AND INTERCEPTORS)
TIOUGHNIOGA RIVER
CHENANGO COUNTY
BROOME COUNTY
CHENANGO RIVER
NANTICOKE VALLEY
CHENANGO VALLEY
BROOME COUNTY
TIOGA COUNTY
OWEGO CREEK
BARNES CREEK
ENDICOTT
BINGHAMTON-JOHNSON CITY
W. OWEGO
FIVE MILE POINT
BIG CHOCONUT CREEK
SUSQUEHANNA RIVER
OWEGO VILLAGE
PUMPELLY CREEK
E. OWEGO
VESTAL
APALACHIN CREEK
MILES
0 1 2 3 4 5

FIGURE V-5

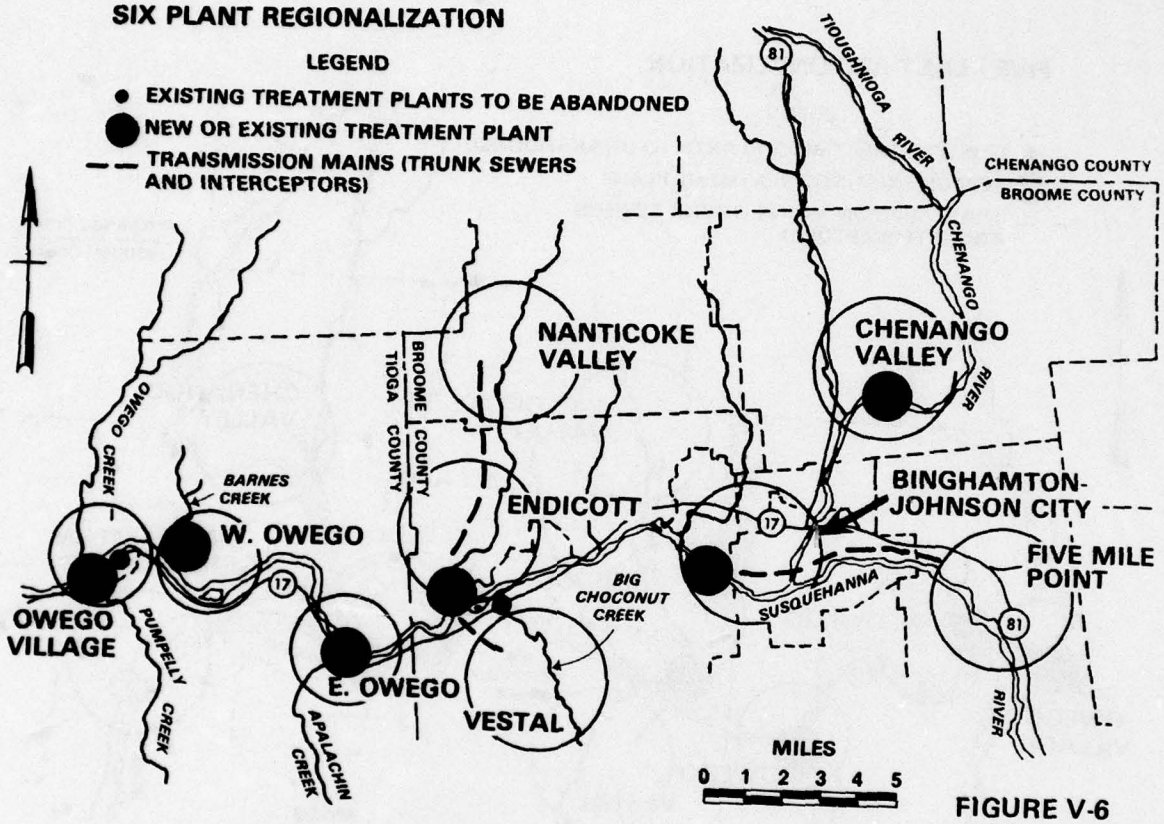

SIX PLANT REGIONALIZATION
LEGEND
EXISTING TREATMENT PLANTS TO BE ABANDONED
NEW OR EXISTING TREATMENT PLANT
TRANSMISSION MAINS (TRUNK SEWERS AND INTERCEPTORS)
TIOUGHNIOGA RIVER
81
CHENANGO COUNTY
BROOME COUNTY
CHENANGO RIVER
NANTICOKE VALLEY
CHENANGO VALLEY
BROOME COUNTY
TIOGA COUNTY
OWEGO CREEK
BARNES CREEK
W. OWEGO
ENDICOTT
BINGHAMTON-JOHNSON CITY
17
FIVE MILE POINT
OWEGO VILLAGE
PUMPELLY CREEK
BIG CHOCONUT CREEK
SUSQUEHANNA
E. OWEGO
VESTAL
APALACHIN CREEK
RIVER
MILES
0 1 2 3 4 5

FIGURE V-6

An extensive network of transmission mains and a completely centralized management system would be required for the region as depicted in Figure V-7.

Categories IX through XII.

These systems all represented departures from what might be called conventional wastewater management. For purposes of comparison, a four plant level regionalization scheme was used for category groups IX through XII. Overall, a four plant system was slightly lower in cost at this level of detail.

IX. Physical/Chemical (P/C) Treatment.

In evaluating the P/C alternatives, it was assumed that existing primary units, secondary aeration tanks (not trickling filters), and clarifiers could be converted to P/C operation. Physical/chemical treatment was proposed as an alternative to the more conventional biological based systems.

X. Land Application.

As was noted earlier, the Binghamton area is not an ideal location for land treatment, primarily due to soils and climate limitations. Preliminary estimates indicated on-site costs alone (exclusive of treatment and transmission) of complete land application substantially exceeded the total costs of AWT. Hence, an attempt was made to devise more feasible land application schemes. The diversion of only a portion of treated effluent and the use of land application only during the months of low river flows essentially put this system in its most favorable light. Alternatives VIII-b and VIII-c represented the least cost land-oriented methods for achieving minimum river DO values of 4 and 5 mg/l, respectively. Alternatives VIII-a was the only plan diverting effluent for year-round land treatment, thereby requiring large storage lagoons during the months of November through April. For Stage II-1, the proposed land application area and the transmission main to the site are shown, along with a four-plant regionalization system, in Figure V-8. Other areas were subsequently located and were discussed later in the report.

BICOUNTY REGIONALIZATION ALTERNATIVES

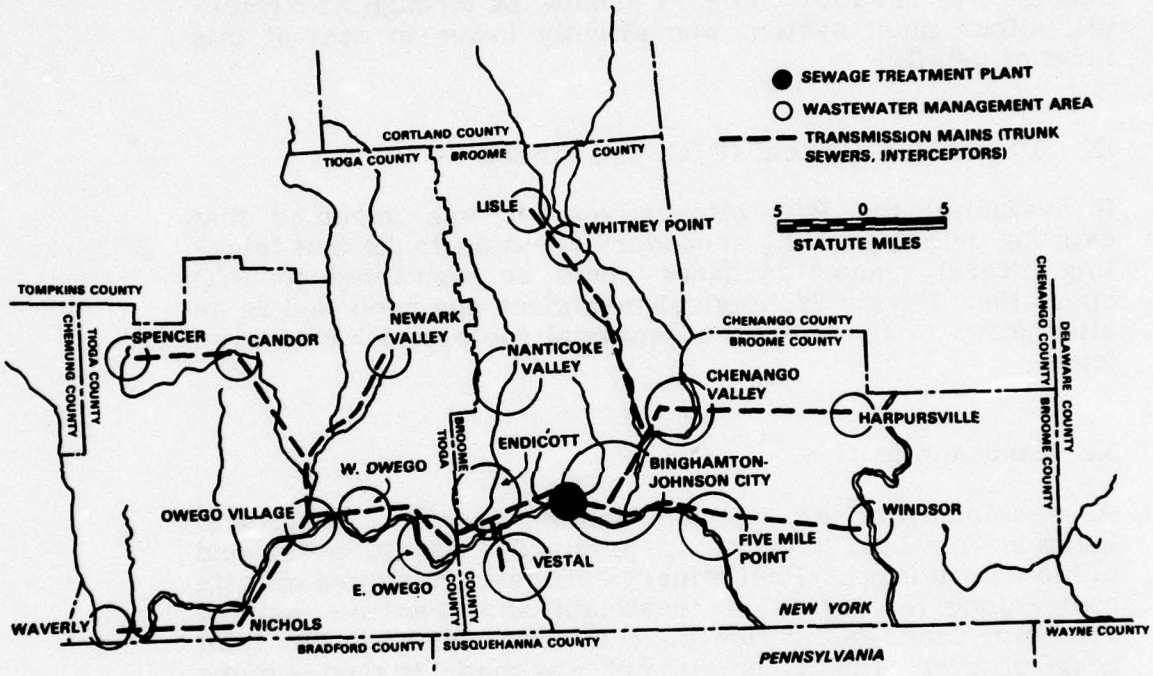


FIGURE V-7

LAND APPLICATION ALTERNATIVES

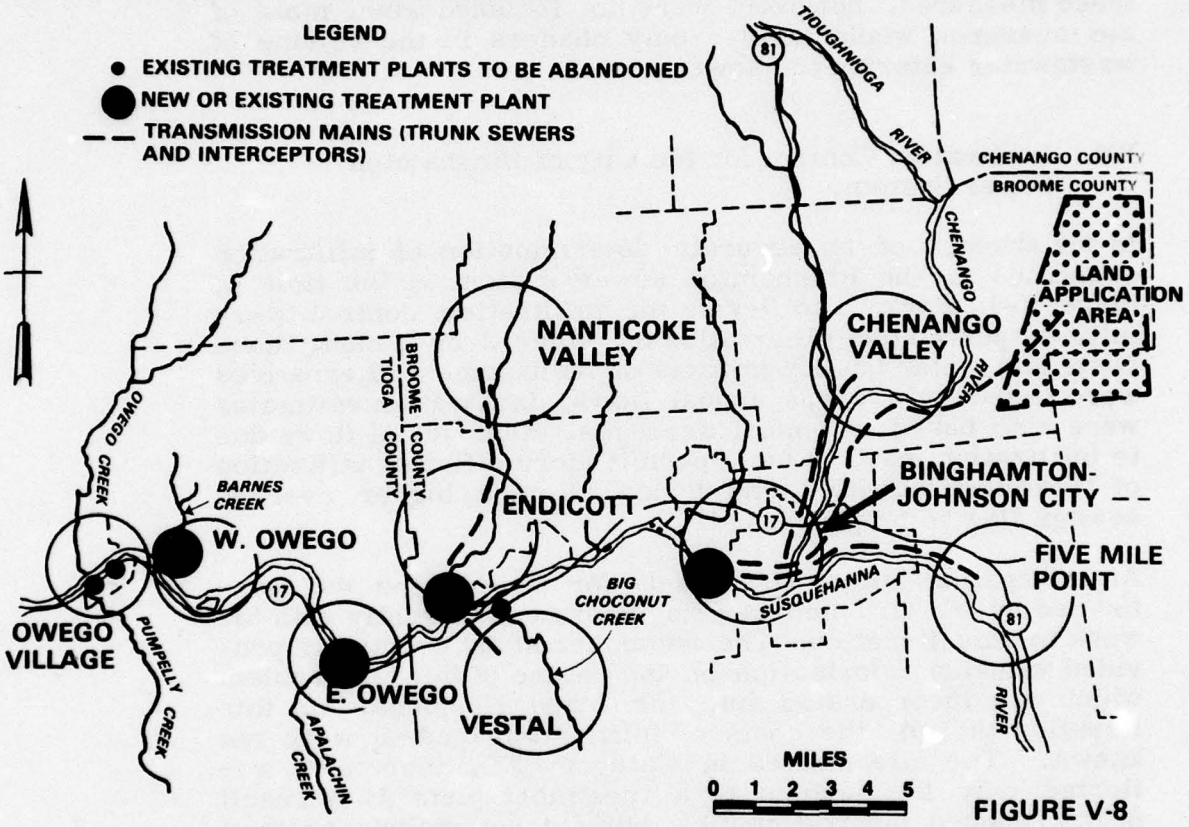


FIGURE V-8

XI. Nonstructural Alternatives.

Nonstructural measures were designed to reduce future wastewater flows. The proposed measures included service area limitation, sewer ordinances, water metering, pricing, water conservation, and public education. A preliminary estimate of the flow reduction achievable by such a program was about 8 mgd for the entire Urban Study Area. Comparison with Category V alternatives indicated the relative cost advantages of the nonstructural measures. Costs for these measures, however, were not included since most of the measures would involve only changes in the volume of wastewater entering the sewers.

XII. Infiltration Control for the City of Binghamton Sewer System.

In the absence of an accurate determination of infiltration quantities in the Binghamton sewer system at the time of Stage II-1 work, two levels of infiltration control were initially postulated: elimination of either 2 or 4 mgd. Since costs and water quality impacts of management alternatives were based on average annual flows, infiltration estimates were also based on annual averages. Removal of flows due to infiltration may, in fact, permit more efficient utilization of treatment facilities and hence allow a higher average sewage flow to be processed.

An infiltration/inflow (I/I) study for Binghamton was performed by V. O. Shumaker Engineers concurrently with the work in this iteration. The Shumaker study eventually provided valuable information on the nature of the I/I problem which was incorporated into the Stage III plans. In this iteration though, the costs of infiltration control were not known. The alternatives in Category XII, therefore, reflected only the savings to a treatment plant as a result of the reduced infiltration flow but did not include costs of infiltration control measures. The control of inflow is analyzed in the stormwater management section later in this chapter.

Alternatives XII-c through f included nonstructural measures, as well as infiltration control, for flow reduction in an attempt to determine the minimum costs of treatment for the area. Since flows to the Binghamton-Johnson City treatment plant would be reduced below current levels, the plant's existing low level of NOD in the effluent (10 mg/l) was assumed in two of the plans, XII-c and XII-d. Comparison of XII-d to XII-e (which included a nitrification

process at Binghamton-Johnson City) was indicative of cost savings associated with high performance at the plant.

Cost Estimates

Construction and operation and maintenance (O & M) costs for Stage II-1 alternatives were based on national averages for treatment processes and transmission mains. All costs were reported in 1974 dollars and adjusted to December 1974 for this Stage. Estimates were made for each treatment plant providing additional capacity and treatment processes as necessary. Savings in O & M costs from closing existing facilities were estimated from national averages. Each transmission main was estimated separately, utilizing the approximate distance from the service area to the treatment plant. All capital costs were increased by 30 percent to reflect engineering fees and contingencies. Cost curves for secondary treatment were obtained from Smith (1970) and Smith and Eilers (1970) for capital costs, and from Eilers (1970) for operation and maintenance costs. For nitrification and advanced waste treatment plants, costs curves and equations were obtained from Monti and Silverman (974), Yang (1974), and the above references used for secondary treatment. The physical/chemical processes of filtration, chemical addition and carbon adsorption were based on Howe (1971).

For land treatment systems, the following references were utilized: Pound and Crites (1973) for design criteria; "Manual of Practice - Regulation of Sewers" (1973) for on-site wastewater distribution costs; and Eckenfelder (1970) for storage lagoon costs.

Transmission main (interceptor) costs were obtained from equations derived by Smith (USEPA, 1971, 1974).

All costs represented the additional costs that would be associated with existing treatment plants and did not include any current expenditures. Treatment plants were amortized over 50 years and interceptors over 50 years, both at 6 percent interest. No salvage value was assumed.

The 40 wastewater management alternatives and associated costs and DO levels are presented in Table V-2.

TABLE V-2

WASTEWATER MANAGEMENT ALTERNATIVES
STAGE II-1

Alternatives	Treatment[1] Level	Capital Cost (10^6)	Net O&M (10^6)	Annual Cost[3] (10^6)	Minimum Average DO (mg/l)
I. 1977 Baseline Condition	Secondary	12	0.6	1.6	2-3
II. Metropolitan Regionalization	(a) NIT	35	0.9	3.3	5-6
	(b) AWT	59	3.0	7.3	5-6
III. Two-Plant	(a) NIT	27	0.8	2.7	5-6
	(b) NIT (1)	24	0.7	2.3	3-4
	(c) Filtration, NIT-Endicott	25	0.9	2.7	4-5
	(d) AWT	54	3.1	7.1	5-6
IV. Three-Plant	(a) NIT	24	0.8	2.5	5-6
	(b) NIT (2)	23	0.7	2.3	5-6
	(c) NIT (1)	20	0.6	2.1	4-5
	(d) AWT	53	3.6	7.6	5-6
V. Four-Plant	(a) NIT	23	0.7	2.4	5-6
	(b) NIT (2)	22	0.6	2.2	5-6
	(c) NIT (1)	20	0.5	2.0	4-5
	(d) AWT	54	3.8	7.9	5-6
VI. Five-Plant	(a) NIT	24	0.7	2.5	5-6
	(b) NIT (2)	22	0.6	2.3	5-6
	(c) NIT (1)	20	0.6	2.0	4-5
	(d) AWT	55	3.9	8.1	5-6

TABLE V-2 (Continued)

Alternatives	Treatment [1] Level	Capital Cost (10^6)	Net O&M (10^6)	Annual Cost [3] (10^6)	Minimum Average DO (mg/l)
VII. Six-Plant	(a) NIT	22	0.8	2.5	5-6
	(b) NIT (2)	20	0.8	2.2	5-6
	(c) NIT (1)	17	0.7	2.0	4-5
	(d) AWT	55	4.3	8.5	5-6
VIII. Complete Regionalization	(a) NIT	46	1.0	4.2	5-6
	(b) AWT	71	3.4	8.6	5-6
IX. Physical/Chemical (4 plants)	(a) NIT	30	1.1	3.4	5-6
	(b) AWT	51	3.3	7.2	5-6
X. Land Application (4 plants)	(a) 80% Year Round	65	3.5	8.2	4-5
	(b) 80% Seasonal	40	1.6	4.4	4-5
	(c) 100% Seasonal	47	2.0	5.3	5-6
XI. Non-Structural[2] (4 plants)	(a) NIT	16	0.5	1.6	5-6
	(b) NIT (2)	15	0.4	1.4	5-6
	(c) NIT (1)	13	0.3	1.1	4-5
	(d) AWT	42	3.1	6.2	5-6

TABLE V-2 (Continued)

Alternatives	Treatment [1] Level	Capital Cost (10^6)	Net O&M (10^6)	Annual Cost[3] (10^6)	Minimum Average DO (mg/l)
XII. Four-Plant System with Infiltration Control [2]					
	(a) NIT-2 mgd reduction	21	0.7	2.2	5-6
	(b) NIT-4 mgd reduction	21	0.7	2.2	5-6
	(c) + Non-structural	9	0.2	0.8	4-5
	(d) (c) + NIT @ Endicott	11	0.3	1.0	5-6
	(e) (c) + NIT (2)	14	0.4	1.4	5-6
	(f) AWT	39	2.8	5.8	5-6

[1] All treatment plants have minimum of secondary treatment. Treatment technologies biological based except for Category IX. Nitrification (NIT) and Advanced Waste Treatment (AWT) applied to all treatment plants except as noted: (1) implies NIT at Binghamton-Johnson City only; (2) implies NIT at Binghamton-Johnson City and Endicott only.

[2] Costs represent treatment and transmission works and do not include costs of infiltration control or non-structural measures. The decreased cost of a treatment system with infiltration control are due to savings achieved by not expanding a plant to handle excess infiltration flows.

[3] Based on economic life of 50 years @ 6% interest. Capital cost includes first cost of both STP's and transmission mains which may or may not be constructed in 1977, depending on need. Therefore, the capital costs column does <u>not</u> represent a present worth of construction expenditures.

IMPACT ASSESSMENT

As alternatives in this iteration were numerous and broadly defined, the assessment of possible impacts resulting from the implementation of such alternatives also were presented in rather broad terms.

Important impacts to be assessed were grouped into the following categories: aquatic ecology, terrestrial ecology, social factors (land use, public health, aesthetic), and economic factors. The short term impacts of construction as well as the long term effects of operation were considered. Table V-3 lists the impact categories and details those elements which were considered in each. These impacts were not separable entities but rather interacted and overlapped each other. An assessment of impacts was accomplished by a comparison of expected effects associated with a particular alternative to expected conditions without the plan (1977 Baseline Conditions).

A summary of both the beneficial and adverse impacts associated with each wastewater management alternative is presented in Table V-4. The magnitude of impacts was rated as having minor, moderate, significant, or no impact in relation to the Baseline Condition.

TABLE V-3

IMPACT CATEGORIES

Impact Category	Elements to be Considered
Aquatic Ecology	Effects of wastewater discharges upon water quality conditions and aquatic flora and fauna, in particular, game fish.
Terrestrial Ecology	Effects of construction and operation of treatment and collection systems on terrestrial flora and fauna, as well as secondary impacts on terrestrial ecology brought about by possible changes in land use patterns.
Social	
Land Use	Effects of plan implementation on land use patterns.
Aesthetic	Effects of physical facilities and river water quality on aesthetic perceptions; effects on cultural, recreational, and historic resources.
Public Health	Effects of operation of wastewater facilities on community health.
Economic	Effects of the cost of regional and local facilities or general economic conditions.

TABLE V-4

IMPACT ASSESSMENT EVALUATION OF WASTEWATER MANAGEMENT ALTERNATIVES FOR STAGE II-1

Alternative	Impact Category					
	Ecological		Social			Economic [2]
	Aquatic	Terrestrial	Land Use	Aesthics[1]	Public Health	Avg. Annual Cost (Millions)
I. Baseline	0	0	0	0	0	1.6
II. Metropolitan Regionalization						
a) Nitrification	significantly beneficial	moderate adverse	moderate adverse	0	minor beneficial	3.3
b) AWT	significantly beneficial	moderate adverse	moderate adverse	0	minor beneficial	7.3
III. Two-Plant						
a) Nitrification	significantly beneficial	moderate adverse	moderate adverse	0	minor beneficial	2.7
b) Nitrification (1)	minor beneficial	moderate adverse	moderate adverse	0	minor beneficial	2.3
c) Filtration	moderate beneficial	moderate adverse	moderate adverse	0	minor beneficial	2.7
d) AWT	significantly beneficial	moderate adverse	moderate adverse	0	minor beneficial	7.1
IV. Three-Plant						
a) Nitrification	significantly beneficial	moderate adverse	moderate adverse	0	minor beneficial	2.5
b) Nitrification (2)	significantly beneficial	moderate adverse	moderate adverse	0	minor beneficial	2.3
c) Nitrification (1)	moderate beneficial	moderate adverse	moderate adverse	0	minor beneficial	2.1
d) AWT	significantly beneficial	moderate adverse	moderate adverse	0	minor beneficial	7.6
V. Four Plant						
a) Nitrification	significantly beneficial	minor adverse	0	0	minor beneficial	2.4
b) Nitrification (2)	significantly beneficial	minor adverse	0	0	minor beneficial	2.2
c) Nitrification (1)	moderate beneficial	minor adverse	0	0	minor beneficial	2.0
d) AWT	significantly beneficial	minor adverse	0	0	minor beneficial	7.9
VI. Five-Plant						
a) Nitrification	significantly beneficial	minor adverse	0	0	minor beneficial	2.5
b) Nitrification (2)	significantly beneficial	minor adverse	0	0	minor beneficial	2.3
c) Nitrification (1)	moderate beneficial	minor adverse	0	0	minor beneficial	2.0
d) AWT	significantly beneficial	minor adverse	0	0	minor beneficial	8.1
VII. Six-Plant						
a) Nitrification	significantly beneficial	0	0	moderate adverse	0	2.5
b) Nitrification (2)	significantly beneficial	0	0	moderate adverse	0	2.2
c) Nitrification (1)	moderate beneficial	0	0	moderate adverse	0	2.0
d) AWT	significantly beneficial	0	0	moderate adverse	0	8.5
VIII. Complete Regionalization						
a) Nitrification	significantly beneficial	significantly adverse	significantly adverse	0	minor beneficial	4.2
b) AWT	significantly beneficial	significantly adverse	significantly adverse	0	minor beneficial	8.6
IX. Physical/Chemical						
a) Nitrification	significantly beneficial	minor adverse	0	0	minor beneficial	3.4
b) AWT	significantly beneficial	minor adverse	0	0	minor beneficial	7.2
X. Land Application						
a) 80% Year Round	moderate beneficial	moderate adverse	0	moderate adverse	minor adverse	8.2
b) 80% Seasonal	moderate beneficial	moderate adverse	0	moderate adverse	minor adverse	4.4
c) 100% Seasonal	significantly beneficial	moderate adverse	0	moderate adverse	minor adverse	5.3
XI. Non-Structural						
a) Nitrification	significantly beneficial	minor adverse	0	0	minor beneficial	1.6
b) Nitrification (2)	significantly beneficial	minor adverse	0	0	minor beneficial	1.4
c) Nitrification (1)	moderate beneficial	minor adverse	0	0	minor beneficial	1.1
d) AWT	significantly beneficial	minor adverse	0	0	minor beneficial	6.2
XII. Infiltration Control						
a) Nitrification + 2 mgd reduction	significantly beneficial	minor adverse	0	0	minor beneficial	2.2
b) Nitrification + 4 mgd reduction	significantly beneficial	minor adverse	0	0	minor beneficial	2.2
c) Non-Struc. +4mgd Red.	moderate beneficial	minor adverse	0	0	minor beneficial	0.8
d) Nitrification (1) + c	significantly beneficial	minor adverse	0	0	minor beneficial	1.0
e) Nitrification (2) + c	significantly beneficial	minor adverse	0	0	minor beneficial	1.4
f) AWT	significantly beneficial	minor adverse	0	0	minor beneficial	5.8

[1] Short term construction impacts will occur with all action alternatives.

[2] 6 percent interest, 50-year project life

SELECTION OF ALTERNATIVES FOR FURTHER STUDY

Evaluation and Screening

In selecting alternatives, every effort was made to choose those systems which provided the greatest flexibility at a later date. The recommended alternatives were based on the following considerations.

Neither single plant nor two plant metropolitan regional schemes were desirable from an environmental or political standpoint. Environmentally, long interceptors would be required with total discharge of wastewater occurring at 1 or 2 points along the Susquehanna River. Energy costs for pumping of wastewater upstream from the Town of Owego would be substantial. If either plant ever experienced a shutdown, large volumes of wastewater would enter the river untreated. Politically, a one or two plant system of regionalization would necessitate a complete overhaul of the existing institutional systems which currently direct wastewater management administration. Additionally, Tioga County would be without a treatment plant and this fact could severely hamper development in that county.

The three, four, five, and six plant regional schemes provided for separate treatment in each county. Broome wastewater would be treated in Broome County while Tioga wastewater would be treated in Tioga County. Secondary treatment at the two larger plants would achieve a DO level above 5 mg/l in the Susquehanna River while cost savings could be achieved by retaining the smaller plants on secondary treatment.

For comparison among various degrees of regionalization, it was also desirable to investigate secondary treatment plus nitrification at Binghamton-Johnson City and Endicott STP's for each degree of regionalization with three or more plants. Three plants might achieve economies of scale normally associated with larger plants; the four plant scheme generally was favorable from a cost viewpoint, an environmental viewpoint, and a political viewpoint; the five plant scheme corresponded most closely with the system that is on-line at the present time; and the six plant scheme investigated the costs and impacts which would be associated with the Chenango Valley plant. For each of these alternatives, IV-b, V-b, VI-b, and VII-b, nitrification would be added at the Binghamton-Johnson City and Endicott plants while the

remaining smaller plants would continue to provide only secondary treatment. Nitrification at all plants had slightly higher costs, and nitrification at only Binghamton-Johnson City did not achieve the 5 mg/l DO level (as calculated by the initial computer program). Thus, comparison of Option b under Alternatives III, IV, V, and VI was a logical means for investigating the optimum scheme of regionalization.

However, the values predicted by the DO model could not be strictly defined as either the minimum daily average (5 mg/l stream standard) or the mqnimum daily value at any time (4 mg/l stream standard). Rather, the actual value predicted by the model was thought to be between the minimum daily average DO and the minimum instantaneous DO. A conservative approach was used in most of the alternatives by designing systems that would result in a predicted DO concentrations of at least 5 mg/l. However, by formulating some alternatives with a DO of between 4 and 5 mg/l, the opportunity for their consideration at a later date was not foreclosed. Thus, Option c, secondary plus nitrification at only the Binghamton-Johnson City plant was selected for the five and six plant schemes.

It was felt at least one alternative should conform to the Federal goal of zero discharge of pollutants by 1985. Therefore, advanced waste treatment (AWT) was chosen for the four plant scheme (Alternative V-d) since this regional system appeared to have considerable merit based on existing political and institutional arrangements within the two counties. If the four plant scheme proved to be unfavorable, then the AWT technology would be evaluated for one of the recommended regionalization systems.

Complete bicounty regionalization (VII-a, b) was unfavorable from environmental, cost, and political viewpoints. Particularly undesirable were the impacts associated with construction of many miles of interceptors without a corresponding favorable impact on overall water quality in the Bicounty Area.

A comparative method of providing AWT was the physical/chemical concept for wastewater treatment (IX-b). All alternatives up to this point had been biologically based treatment systems, and physical/chemical treatment was selected to provide a comparison as a totally different system. The four plant regional scheme was picked in order to be comparable to the four plant biological AWT mentioned earlier.

Similarly, a land treatment scheme was desirable as an alternative to either the biological system or the physical/chemical system. Soils, geology, and climate appeared unfavorable for year-round application of wastewater. Large storage lagoons were also considered to have adverse impacts because of the land requirements and associated costs. Consequently, seasonal application of 100% of Binghamton-Johnson City's secondary treated effluent to the land looked like the most promising land treatment alternative (X-c) which maintained a DO level of 5 mg/l or greater. Once again, the four plant regional scheme was used for comparative purposes.

A nonstructural alternative would investigate the possibility of controlling water quality by reducing influent volumes to the treatment plants. Cost savings were possible because smaller plants and hence less costly plants could handle the influent flows. The four plant scheme with nitrification added at the two larger plants (XI-b) provided the necessary comparison to Alternative V-b. Thus, the benefits of a nonstructural measure could be gaged against the costs and impacts of the same alternative assuming no limits on wastewater flows. Nonstructural methods could be applied to any alternative in an attempt to control the volume of wastewater flow.

Another means of reducing flow to treatment plants was by infiltration control. An approximate value for flow reduction achievable by infiltration control was about 4 mgd for the City of Binghamton. In other words, any Binghamton-Johnson City STP expansion could be designed for 4 mgd less than originally planned. A smaller plant and smaller influent volumes would mean less capital costs for construction and less operation and maintenance costs over the life of the plant. Alternative XII-b provided secondary plus nitrification at all four plants with a 4 mgd reduction in volume of wastewater due to infiltration control. The calculated costs represented only treatment and major transmission costs. No sewer rehabilitation costs to control infiltration were included in this iteration.

To investigate the total possible flow reduction scheme, infiltration control plus nonstructural measures with nitrification added at only Endicott was recommended. This alternative (XII-d) achieved the 5 mg/l DO at a minimum of cost.

Some form of stormwater management was recommended that could be applied to any of the above alternatives. This item would achieve even more flow reduction. (See Stormwater Management Section in this chapter).

Recommended Alternatives

With the above considerations having been expressed by the management and advisory committees in the screening process, thirteen alternatives were recommended for more detailed refinement in Stage II-2. In selecting these alternatives, the ISMG, CAC, and TAC were particularly concerned with those systems which provided the greatest flexibility at a later date while achieving the objectives of the Study. This would prevent foreclosing consideration of many possible combinations of systems until they were fully investigated. Several meetings of the three committees were held as the 40 alternatives were narrowed to the following 13 alternatives.

I. 1977 Baseline Condition. Five secondary treatment plants; sewerage provided to new growth in existing service areas but no expansion of treatment facilities.

Three Plant Regional Scheme:

IV-b. Secondary plus nitrification at Binghamton-Johnson City and Endicott with secondary treatment at Town of Owego STP No. 2.

Four Plant Regional Schemes:

V-b. Secondary plus nitrification at Binghamton-Johnson City and Endicott with secondary treatment at Town of Owego STP's No. 1 and 2.

V-d. Biological AWT at all plants.

IX-b. Physical/Chemical AWT at all plants.

X-c. Land application - secondary treatment at all plants; 100% of flow from Binghamton-Johnson City plant would be applied to land on a seasonal basis.

XI-b. Nonstructural - Secondary treatment plus nitrification at Binghamton-Johnson City and Endicott with secondary treatment at Town of Owego STP's No. 1 and 2.

XII-b. Four mgd infiltration flow reduction in Binghamton with secondary plus nitrification at all plants.

XII-d. Four mgd infiltration flow reduction in Binghamton with nonstructural measures plus secondary treatment at three plants and nitrification added at Endicott.

Five Plant Regional Schemes:

VI-b. Secondary treatment plus nitrification at Binghamton-Johnson City and Endicott with secondary treatment at Town of Owego STP's No. 1 and 2 and Owego Village.

VI-c. Secondary treatment at all plants with nitrification added at Binghamton-Johnson City only.

Six Plant Regional Schemes:

VII-b. Secondary treatment plus nitrification at Binghamton-Johnson City and Endicott with secondary treatment at Town of Owego STP's No. 1 and 2, Owego Village, and Chenango Valley.

VII-c. Secondary treatment at all plants. Nitrification added at Binghamton-Johnson City only.

STAGE II - ITERATION 2 ALTERNATIVES

REFINEMENTS AND MODIFICATIONS

At the completion of Stage II-1, which presented an evaluation of 40 alternatives for wastewater management in the metropolitan region of Broome and Tioga Counties, the Interagency Study Management Group recommended twelve of these, in addition to the 1977 Baseline Alternative, be carried through for further study.

In Stage II-1, because of the large number of alternatives under consideration, design, costs, impact assessments, and evaluation were defined only in a preliminary manner.

Broad assumptions were necessary under such categories as interceptor routing, treatment plant expansion design, construction scheduling, and financial impact. Stage II-2 was therefore conceived as having a twofold purpose: (1) refinement, assessment, and evaluation to provide a basis for reducing the number of alternatives even further; and (2) development of specific technological analyses upon which the refinements in Stage II-2 could be based, and which would require as little revision as possible in Stage III. These

refinements in Stage II-2 included revisions in cost analyses, treatment processes, land treatment sites, the dissolved oxygen model, and flow projections, as discussed below.

Cost Analyses

Previously, for the purpose of simplified cost analyses, it was assumed all construction would take place in 1977. Beginning with this iteration, construction of treatment and disposal works were phased in time. Construction schedules providing minimum cost systems were developed by delaying the addition of new facilities until they were needed due either to legal requirements or increased flows. The impact of economy of scale on construction phasing was also taken into account. Major interceptors were scheduled for construction in 1977 and designed for the year 2020 flow rates.

The replacement of treatment plant units was also considered in the analysis. Predicting the time of replacement for any major capital item is difficult and complex as some parts of a treatment system require replacement earlier than others; e.g., structural elements have longer useful lives than pieces of control equipment, which in turn, have longer useful lives than process equipment. As refining cost estimates and replacement schedules to account for these individual factors was beyond the detail needed for this iteration, a simplified approach was used. A single "effective" useful life for all parts of a treatment plant was used. It was computed by summing the present worths of individual replacement items and using this value to determine that period of time for which the entire treatment system could be replaced in a single construction project. Useful lives of treatment units taken from EPA guidelines (1974) and a typical breakdown of costs for structures, major process equipment, and control equipment (Manne, 1967; Richford, 1969; Smith and Eilers, 1971) resulted in a computed effective useful life of 27 years. For each alternative, all treatment units were assumed to be replaced 27 years after installation.

Estimates of costs were in December 1974 dollars and accounted for specific study area factors as well as preliminary designs of most of the major capital elements.

Operation and maintenance costs for secondary treatment were based on cost curves developed from actual operating

costs for secondary treatment plants in Broome and Tioga Counties. The O & M costs were assumed to be proportional to design flow as these costs are more dependent upon plant capacity than on actual flow rates. The capital and O & M costs for the nitrification and AWT alternatives were, in general, taken from cost curves (which included sludge handling costs). Present worth costs were based on a 5 7/8% rate of interest as was then specified by the Water Resources Council.

Physical/Chemical Advanced Waste Treatment

The physical/chemical based AWT scheme for this Iteration was different from that used previously because of two considerations: (1) this scheme should provide a real alternative, in terms of unit processes, to the biological based AWT; and, (2) to determine the most efficient route providing advanced waste treatment, construction should proceed directly from secondary treatment to AWT without the intermediate step of Best Practicable Waste Treatment Technology (BPWTT).

The P/C system was used for this direct approach to the 1985 goal because no point in the P/C treatment sequence could be labelled specifically as providing the 1983 requirement of BPWTT. (For the biological based AWT system, this intermediate step was assumed to be achieved by the addition of nitrification.)

The scheme chosen for P/C treatment involved four major treatment processes. These were: alum addition to the primary clarifer, breakpoint chlorination (for nitrogen removal), filtration, and activated carbon adsorption.

The physical/chemical advanced waste treatment system was designed to meet or approach all of the 1985 zero discharge target concentrations (as defined by the Corps of Engineers), and be of similar quality to the biological based AWT effluent.

Biological Advanced Waste Treatment

Advanced waste treatment, biological based, also had the intention of producing an effluent meeting or approaching

target values for zero discharge published by the Corps of Engineers.

The biological based AWT scheme consisted of the following components in treatment order (following secondary treatment and nitrification): denitrification, phosphorus removal, filtration, and activated carbon adsorption.

This sequence was quite similar to the one for biological AWT used in Stage II-1; the only significant difference was the dual use of the denitrification clarifier for activated sludge settling and phosphorus removal.

Land Treatment

Previously, the land treatment alternative consisted of seasonal (summer) spray irrigation of the liquid effluent from the Binghamton-Johnson City treatment plant. Application of the effluent year-round was considered unfeasible because of the costs associated with storing the flow during the winter. The application site evaluated was 17 miles to the northeast of the treatment plant, resulting in considerable capital costs for the required force main.

In this iteration, a detailed analysis of the Bicounty Study Area was made to determine if more advantageous sites could be found. Selection of the most suitable sites was made by consideration of such factors as: (a) distance from the plant; (b) population density and extent of human activity within the application area; (c) location and number of surface waters in the proposed site; (d) suitable existing land usage, i.e., agriculture and forest; and (e) suitable soils and slopes. The conclusion of this investigation was that there were sites more readily developable for land application of the Binghamton-Johnson City effluent than the previous site of Stage II-1. In fact, this analysis also indicated there were sites of sufficient size, suitability, and proximity to Owego to warrant evaluation of land application of the liquid effluents from that area as well as from Binghamton. Plate No. 1 shows these suitable sites, including the site used in the Stage II-1 analysis (Site #1).

Preliminary analyses indicated that Sites 1, 3, and 4 had higher costs without compensating advantages. Therefore, following secondary treatment, Binghamton-Johnson City effluent would be sprayed at Site #2, West Owego's (Town of Owego STP No. 1) at Site #5a, and East Owego's (Town of Owego STP No. 2) at Site #5b.

In summary, the land treatment alternatives had three aspects which differed from Stage II-1: (1) application site for Binghamton-Johnson City was changed; (2) effluent from Town of Owego STP's No. 1 and 2 was applied to the land; and (3) as the costs of land application were strongly dependent on flow rates, two flow rates were evaluated (maximum, i.e., no flow reduction measures; and minimum, i.e., nonstructural measures throughout the study area plus infiltration control at Binghamton).

Dissolved Oxygen Model

Previously, the reaeration coefficients for the Susquehanna River dissolved oxygen (DO) model had been based on an energy dissipation formula as information of the river's geometry was not available in earlier iterations. When cross-sectional data on the river became available, a redetermination of the reaeration coefficients was made based on velocity and depth of flow. This latter approach is the more traditional method. This recalculation resulted in increases of predicted DO levels by 0.5 to 1.5 mg/l at critical low flows. The importance of these changes was reflected in the impact analysis where a revision in the relationship between level of treatment and resulting river DO was necessary. The following summary is a list of significant changes applied to this iteration because of the revisions to the DO model.

1. The 1977 Baseline Condition, assuming no expansion of the Binghamton-Johnson City plant and secondary treatment at the remaining four plants, resulted in a minimum dissolved oxygen of 3.5 mg/l by the year 2020 (previously estimated value was 2.2 mg/l).

2. Expanding the secondary capacity of the Binghamton-Johnson City plant and providing secondary treatment at all other STP's increased the minimum DO above 4 mg/l until the year 2020 but would be less than 5 mg/l by 1983.

3. With secondary treatment at all plants, the addition of nitrification at Binghamton-Johnson City alone was sufficient to maintain the DO above 5 mg/l. Nitrification at the Endicott plant was no longer needed to maintain the higher DO level. In addition, nitrification at the Binghamton-Johnson City facility could be delayed beyond 1983, or eliminated entirely, depending on the amount of flow reduction attained by infiltration control and nonstructural

measures. The DO concentrations listed were for dry weather flows only. Combined sewer overflows during certain storm conditions would significantly reduce these values if no storm overflow measures are taken.

Stage II-2, Flow Projections

Previously, it had been assumed per capita water consumption and sewage contribution would increase by 10 percent per decade through the year 2020. A re-analysis led to the conclusion that this assumption yielded unrealistically high flows as this rate would result in a 62 percent increase in flows by the year 2020. Although a 10 percent rate reflects the lower range of historic trends in water consumption for comparable urban areas, such forecasts of continued exponential growth were highly questionable and not found in similar studies for future growth in the next 50 years. For this reason, a 10 percent increase per decade in per capita wastewater was used only up to 1990. The increase in per capita flow was tapered to 5 percent between 1990 and 2000 and no increase was projected thereafter. The overall increase in flow by 2020 was 27 percent, which falls within the range of several randomly selected water and sewer studies as displayed in Table V-5.

TABLE V-5

PER CAPITA WATER USE TRENDS AND PROJECTIONS

Study	Area	Per Capita Increases Reported	Equivalent 50 Year Increase to Year 2020
(1) Linaweaver	USA	About 9%/decade increase since 1900 estimated	54% (to 1950)
(2) TSC	Southeastern New York State	0.5 gpcd per year increase projected equivalent to initial increases of 4 1/2% per decade declining to 4% per decade	22%
(3) Holzmacher	Long Island, NY	General average increase of 2%/ decade projected	9%
(4) Greeley & Hanson	Long Island, NY	6% per decade increases declining to 1-1 1/2% per decade increases projected	15%
(5) New Jersey	Northeastern New Jersey	9%/decade increase declining to 6%/decade increases projected	44%
(6) Binghamton Wastewater Management Study - Stage I	Binghamton, NY	10%/decade projected	62%
(7) Binghamton-Stage II	Binghamton, NY	10%/decade declining to 0% by 2000	27%

REFERENCES:

1. F. P. Linaweaver, et. al. A Study of Residential Water Use (U. S. HUD, 1967).
2. Temporary State Commission on the Water Supply Needs of Southeastern New York. Scope of Public Water Supply Needs (1972).
3. Holzmacher, McLendon, and Murrell. Suffolk County Comprehensive Water Supply Study (1968).
4. Greeley & Hanson. Nassau County Comprehensive Water Supply Study. (1971)
5. New Jersey Division of Water Policy and Supply. Water Resource Circular 21. (1969).
6. Quirk, Lawler & Matusky. Binghamton Wastewater Management Study: Phase I (1974).

Estimated increases in per capita flow rates projected through the planning period are presented in Table V-6.

TABLE V-6

PROJECTED INCREASE IN PER CAPITA WASTEWATER FLOWS

Decade	Percent Increase in Per Capita Sewage Flow
1970-1980	10
1980-1990	10
1990-2000	5
2000-2010	0
2010-2020	0

The revised flow projections are shown on Table V-7. For these forecasts, it was assumed there would be no control of infiltration or inflow and no reduction due to nonstructural measures.

Stage II-2 Flow Projections for Nonstructural Measures

Previously, it had been assumed that nonstructural measures would include limitation of water and sewer service areas. Local representatives to the Technical Advisory Committee (TAC) were opposed to this component of the nonstructural alternative. Particular reference was made to recent court rulings in California where municipalities were now obliged to provide community service, such as sewering, to all residents. The TAC members felt land use zoning was a more effective approach to controlling growth. Therefore, the nonstructural measures were revised for this iteration to include zoning as well as pricing, metering, sewer ordinances, public education, and water conservation devices. Table V-8 shows the revised flow projections with implementation of nonstructural measures, again with no control of inflow/infiltration.

The impact of not withholding sewer service, in terms of treatment plant loads, was small in comparison to Stage II-1 flow estimates because the populations originally planned for sewer withholding were small.

TABLE V-7

STAGE II-2
WASTEWATER FLOW PROJECTIONS
(Million gallons per day)

Wastewater Management Area[1]	1973[3]	1980	2000	2020
Binghamton-Johnson City	18.3	21.6	24.5	25.4
Endicott	4.3	7.1	8.9	9.2
Chenango Valley[2]	-	1.7	2.2	2.4
East Owego (Town of Owego STP No. 2)	0.4	1.2	2.5	2.8
West Owego (Town of Owego STP No. 1)	0.2	0.6	1.2	1.5
Owego Village	0.9	0.7	0.8	0.9
TOTAL	24.1	32.9	40.1	42.2

[1] Five Mile Point wastewater flows treated at Binghamton-Johnson City Joint Sewage Treatment Plant by 1977; Vestal (sub-area V-2 and V-3) and Nanticoke Valley flows treated at Endicott by 1977.

[2] Presently not sewered.

[3] Current sewage treatment plant flow.

TABLE V-8

STAGE II-2 REDUCED WASTEWATER FLOWS FOR NONSTRUCTURAL ALTERNATIVES

Wastewater Management Area[1]	1973[3]	1980	2000	2020
Binghamton-Johnson City	18.3	20.3	20.8	21.4
Endicott	4.3	6.6	7.2	7.3
Chenango Valley[2]	-	1.6	1.7	1.9
East Owego (Town of Owego STP No. 2)	0.4	1.1	2.0	2.2
West Owego (Town of Owego STP No. 1)	0.2	0.5	0.7	0.9
Owego Village	0.9	0.7	0.6	0.6
TOTAL	24.1	30.8	33.0	34.3

[1] Five Mile Point wastewater flows treated at Binghamton-Johnson City Joint Sewage Treatment Plant by 1977; Vestal (sub-area V-2 and V-3) and Nanticoke Valley flows treated at Endicott by 1977.

[2] Presently not sewered.

[3] Current sewage treatment plant flow.

Comparison of Revised Alternatives With the Previous Iteration

Many of the alternatives recommended by the management committees in Stage II-1 achieved a DO of either 4 or 5 mg/l at least cost. This is shown in the fact that alternatives supplying nitrification at only the Binghamton-Johnson City and Endicott plants were chosen in preference to those that applied nitrification at all plants. Revision of the reaeration coefficient for the DO model resulted in the conclusion the DO levels predicted in Stage II-1 were too low and that, for example, nitrification would not be needed at Endicott in any of the alternatives to meet a DO concentration of 5 mg/l. Where the Committees' intention was to achieve a certain minimum DO at least cost, the required treatment was upgraded beyond the secondary level only when and where needed to meet the DO target.

Table V-9 summarizes the major features of the revised alternatives and, where applicable, a description of the changes from the corresponding Stage II-1 alternatives is given. Changes were made in such a way that the targets, primarily DO, would remain the same as for the recommended alternatives in the previous iteration.

TABLE V-9

COMPARISON OF STAGE II ALTERNATIVES

Stage II-2 No.	Description [1]	Corresponding Stage II-1 No.	Description of Modification
1	1977 Baseline Condition 5 plants (2+3) [2]	I	Same
2	3 plants (2+1) - Nitrification at Binghamton-Johnson City	IV-b	Nitrification at Endicott not necessary to meet 5 mg/l DO
3a	4 plants (3+1) - Nitrification at Binghamton-Johnson City	-	New alternative to find optimum STP's
3b	4 plants (2+2) - Nitrification at Binghamton-Johnson City	V-b	Nitrification at Endicott not necessary to meet 5 mg/l DO
4a	5 plants (3+2) - Nitrification at Binghamton-Johnson City	-	New alternative to find optimum STP's
4b	5 plants (2+3) - Nitrification at Binghamton-Johnson City	VI-b	Nitrification at Endicott not necessary to meet 5 mg/l DO
5	6 plants (3+3) - Nitrification at Binghamton-Johnson City	VII-b	Nitrification at Endicott not necessary to meet 5 mg/l DO
6	Biological Advanced Waste Treatment - 5 plants (3+2)	V-d	New plant at Chenango; infiltration control at Binghamton included

TABLE V-9 (Continued)

Stage II-2 No.	Description [1]	Corresponding Stage II-1 No.	Description of Modification
7	Physical/Chemical Advanced Waste Treatment - 5 plants (3+2)	IX-b	New plant at Chenango; different unit processes; infiltration control at Binghamton included
8a	Seasonal Land Treatment 5 plants (3+2)	X-c	New plant at Chenango; change in application sites; Owego effluents applied to the land
8b	Seasonal Land Treatment Non-structural measures plus infiltration control at Binghamton, 5 plants (3+2)	--	New alternative, decreases land requiremants
9	Non-structural Measures 5 plants (3+2)	XI-b	Nitrification not necessary; new plant at Chenango
10	Nitrification at all plants Infiltration control at Binghamton, 5 plants (3+2)	XII-b	New plant at Chenango
11	Non-structural Measures Infiltration control at Binghamton, 5 plants (3+2)	XII-d	New plant at Chenango
12a	Secondary, 5 plants (2+3)	VI-c	Nitrification not necessary to meet 4 mg/l

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TABLE V-9 (Continued)

Stage II-2 No.	Description [1]	Corresponding Stage II-1 No.	Description of Modification
12b	Secondary, 6 plants (3+3)	VII-c	Nitrification not necessary to meet 4 mg/l
13	Infiltration control at Binghamton, 5 plants (3+2)	--	New alternative Evaluate infiltration control

[1] All plants assume a minimum of secondary treatment.

[2] (2+3) refers to the number of sewage treatment plants in Broome County plus the number in Tioga County, respectively. Broome County plants are located at: Binghamton-Johnson City and Endicott (2) or Binghamton-Johnson City, Endicott, and Chenango Valley (3). Tioga County plants are located at: East Owego (1); East and West Owego (2); or East Owego, West Owego, and Owego Village (3).

Stage II-2 alternatives were grouped in the order shown in in Table V-10.

TABLE V-10

STAGE II-2 ALTERNATIVES BY CATEGORY

Alternative Number	General Description
1	1977 Baseline Condition
2 through 5	Alternatives which compare degrees of regionalization and meet 5 mg/l DO
6 through 8	Alternatives comparing levels of treatment efficiency
9 through 11	Alternatives which compare effects of flow reduction
12	Alternative achieving 4 mg/l DO
13	Additional alternative to test effect of flow reduction

The following components were analyzed in greater detail to allow further screening of the alternatives: degree of regionalization in Tioga County (one, two, or three treatment plants); and application of nonstructural measures and infiltration control. Also, the environmental, social, and economic impacts of different levels of treatment (i.e., secondary, secondary plus nitrification, and advanced waste treatment) were further assessed and evaluated.

In order to enable the analysis of the above decision components, four new alternatives were developed (Nos. 3a, 4a, 8b, 13). The first two provided a direct comparison (with 3b and 4b) of the impacts of constructing a new facility in Chenango Valley, and of providing the optimum number (one, two, or three) of plants in Tioga County. Alternative 8b provided flow reduction measures to decrease land requirements and associated costs of land treatment systems. Number 13 was added to further evaluate infiltration control while providing a minimum amount of treatment.

Previously, the Chenango Valley plant was included in only one regionalization system - six plants. The management groups felt a closer examination of this proposed plant was warranted. The Chenango Valley plant was analyzed for three degrees of regionalization (4, 5, and 6 plants), and was included in many of the schemes (Alternatives 6, 7, 8a, 9, 10, and 11). This was done to enable analysis of nonstructural measures, infiltration control, and levels of treatment. Most of these alternatives included some form of flow reduction, either by nonstructural methods and/or infiltration control in the City of Binghamton. By providing for separate treatment of Chenango Valley wastewater, the effectiveness of flow reduction measures and treatment levels for the Binghamton-Johnson City plant were easier to to analyze. This was due to the wide range of flows that could enter the Binghamton-Johnson City plant, which included, in addition to its present service area, existing infiltration and stormwater, and additional municipal and industrial flows resulting from future development.

Infiltration control for the City of Binghamton was included for alternatives 6 and 7 as the substantial cost savings in capital, operation and maintenance costs became apparent for advanced waste treatment. The cost effective level of infiltration control (the amount of infiltration cheaper to prevent than to treat) was strongly dependent on the treatment technology to be applied at the sewage treatment plant. That is, as the degree of treatment and cost/gallon treated increased, greater amounts of infiltration could be economically eliminated. In the land treatment systems, the value of flow reduction was tested by assuming two cases, with and without flow reduction.

DESCRIPTION OF ALTERNATIVES

1977 Baseline Condition (Alternative 1)

Impacts associated with the 1977 Baseline Alternative formed the basis against which all wastewater management alternatives were compared. However, the 1977 Baseline Alternative also had impacts when compared to existing environmental conditions. The changes from existing conditions expected to occur under the Baseline Condition are given below.

It was assumed no wastewater treatment plants would be added or expanded and only the Owego Village Plant would be upgraded. Expansion of the existing service areas was assumed to continue following the existing trends. The interceptors approved by NYSDEC for funding by 1977 were included in the 1977 Baseline Condition. However, the Chenango Valley interceptor was not included in the Baseline as Broome County was studying other alternatives. The interceptors, providing service for growth areas outlined in the Broome County Sewerage Feasibility Study, were assumed to be part of the 1977 Baseline Alternative. Plate 3 shows regional interceptors and STP's included in the Baseline Condition.

The following is a summary of the currently proposed facilities to be included in the Baseline Alternative.

1. Abandonment of the Vestal Sewage Treatment Plant (STP) and diversion of its wastewater via a new interceptor to the Endicott STP.

2. Upgrading the Owego Village STP to provide secondary treatment.

3. Abandonment of the Owego Valley View STP and diversion of its wastewater to an upgraded Owego Village STP.

4. The remaining existing STP's, including Binghamton-Johnson City STP, Town of Owego STP #2 (East Owego), Town of Owego STP #1 (West Owego), and Endicott STP would not be expanded or upgraded.

5. The Chenango Valley area would continue to be served by septic systems.

6. Extensions of sewage collection and treatment services would take place within the Nanticoke Creek Valley and toward the Five Mile Point area.

7. The sewered population to all STP's would continue to grow and sewage flows would continue to increase.

Alternative 2: Three Plants (2+1); Nitrification at Binghamton-Johnson City

This 3-plant regionalization scheme included two STP's in Broome County (Binghamton-Johnson City and Endicott) and

one for Tioga County (Town of Owego #2). In order to maintain a minimum DO level in the Susquehanna River above 5 mg/l (except during combined sewer overflow conditions), secondary treatment plus nitrification for ammonia removal would be applied to the Binghamton-Johnson City STP by the year 1983. Secondary treatment would be sufficient at the other two plants.

Alternative 3a: Four Plants (3+1); Nitrification at Binghamton-Johnson City

This alternative included 3 STP's in Broome County (Binghamton-Johnson City, Endicott, and a new plant for Chenango Valley), and one for Tioga County (Town of Owego STP No. 2). Secondary treatment at all plants by 1977 plus nitrification at the Binghamton-Johnson City STP by 1983 would maintain a minimum of 5 mg/l DO in the Susquehanna River except during combined sewer overflow conditions.

Alternative 3b: Four Plants (2+2); Nitrification at Binghamton-Johnson City

This alternative included two STP's for Broome County (Binghamton-Johnson City and Endicott) and two for Tioga County (Town of Owego STP's No. 1 and 2). All facilities This level of treatment would maintain the DO level in the Susquehanna River above 5 mg/l except during periods of combined sewer overflows.

Alternative 4a: Five Plants (3+2); Nitrification at Binghamton-Johnson City

This alternative includes three STP's in Broome County (Binghamton-Johnson City, Endicott, and a new plant in Chenango Valley) and two in Tioga County (Town of Owego STP's No. 1 and 2). All facilities would apply secondary treatment by 1977 with Binghamton-Johnson City adding nitrification by 1983. The minimum DO level in the Susquehanna River would be 5 mg/l except during combined sewer overflow conditions.

Alternative 4b: Five Plants (2+3); Nitrification at Binghamton-Johnson City

This alternative included two STP's in Broome County (Binghamton-Johnson City and Endicott) and three in Tioga County (Town of Owego STP's No. 1 and 2, and Owego Village). Secondary treatment at all facilities by 1977 plus nitrification at Binghamton-Johnson City by 1983 would result in a minimum DO level of 5 mg/l in the Susquehanna River except during periods of combined sewer overflows.

Alternative 5: Six Plants (3+3); Nitrification at Binghamton-Johnson City

This alternative included three STP's in Broome County (Binghamton-Johnson City, Endicott, and a new plant in Chenango Valley), and three in Tioga County (Town of Owego STP's No. 1 and 2 and Owego Village). To maintain a minimum of 5 mg/l DO in the Susquehanna River (except during periods of combined sewer overflows), secondary treatment at all facilities by 1977 plus nitrification at the Binghamton-Johnson City plant by 1983 would be required.

Alternative 6: Biological Advanced Waste Treatment; Five Plants (3+2); Infiltration Control at Binghamton

This alternative provided nitrification by 1983 and advanced waste treatment (AWT) by 1985 for the following facilities: Binghamton-Johnson City, Endicott, and Chenango Valley in Broome County, and Town of Owego STP's No. 1 and 2 in Tioga County. Following secondary treatment and nitrification, AWT would provide denitrification for nitrogen removal, alum addition for phosphorus removal, filtration to remove suspended solids, and carbon adsorption for removing the remaining organics.

Analysis of advanced waste treatment cost data and information provided by the infiltration study for the City of Binghamton indicated infiltration control would become cost-effective as the treatment level increased to advanced waste treatment.

The DO level in the Susquehanna River would be maintained above 6 mg/l except during occurrences of combined sewer overflows during certain storm conditions.

Alternative 7: Physical/Chemical Advanced Waste Treatment; Five Plants (3+2); Infiltration Control at Binghamton

This alternative proceeded directly from secondary treatment to advanced waste treatment for all treatment plants in 1985 with no intermediate nitrification step. The purpose of this approach was to determine which pathway to the 1985 zero discharge goal serves the Federal, State, and local interests from financial, environmental, and social viewpoints. Treatment plants included in this scheme were Binghamton-Johnson City, Endicott, and a new plant in Chenango Valley for Broome County; and Town of Owego STP's No. 1 and 2 for Tioga County. Major treatment processes included alum addition to the primary clarifier, breakpoint chlorination for nitrogen removal, filtration, and carbon adsorption. The DO level in the Susquehanna River would be maintained above 6 mg/l except during occurrences of combined sewer overflows during certain storm conditions.

Alternative 8a: Seasonal Land Treatment; Five Plants (3+2)

This alternative provided for seasonal (May through October) land application of secondary effluent from the Binghamton-Johnson City STP, Town of Owego STP No. 1 (West Owego), and STP No. 2 (East Owego). Land application site numbers were 2, 5a, 5b, as shown on Plate 1. The remaining STP's, Chenango Valley, and Endicott, would discharge secondary effluent to the river.

Of the various land treatment methods, spray irrigation systems were found to be the most suitable for the Bicounty Area. During summer, river flows are generally low and wastewater has a more critical impact on the DO of the stream. During the winter months of November through April, when river flows are higher, secondary effluent from all facilities would discharge directly to streams. The DO level in the Susquehanna River would be maintained above 6 mg/l except during periods of combined sewer overflows.

Alternative 8b: Seasonal Land Treatment; Nonstructural Measures; Infiltration Control; Five Plants (3+2)

This alternative was identical to Alternative 8a except that nonstructural measures would be applied to all the wastewater management areas to reduce flows by 7 mgd. Infiltration control in the Binghamton sewerage system would be applied to further reduce flows by 4.5 mgd. Total flow reduction would therefore be 11.5 mgd.

The land application sites investigated and their pipeline routes to the treatment plants are shown in Plate 1. The DO in the Susquehanna River would be maintained above 6 mg/l except during periods of combined sewer overflows.

Alternative 9: Nonstructural Measures: Five Plants (3+2)

This alternative would incorporate nonstructural measures throughout the Urban Study Area to maintain the per capita wastewater flows at current levels. Treatment plants at Binghamton-Johnson City, Endicott, and Chenango Valley would serve Broome County, and the Town of Owego STP's No. 1 and 2 would serve Tioga County.

In order to maintain a minimum DO level in the Susquehanna River above 5 mg/l, nitrification would be applied to the Binghamton-Johnson City plant by 2000.

Alternative 10: BPWTT at all Plants; Infiltration Control at Binghamton; Five Plants (3+2)

Strictly interpreted, Public Law 92-500 requires Best Practical Waste Treatment Technology (BPWTT) at all municipal sewage treatment plants by 1983. For this Study, BPWTT was defined as secondary treatment plus nitrification. This level of treatment would be applied to the Binghamton-Johnson City, Endicott, and Chenango Valley facilities in Broome County and the Town of Owego STP's No. 1 and 2 in Tioga County. Additionally, infiltration control at the City of Binghamton was assumed to reduce plant flow by an average daily amount of 4.5 mgd.

The minimum DO level in the Susquehanna River would be 5-6 mg/l, except during periods of combined sewer overflows.

Alternative 11: Nonstructural Measures; Infiltration Control; Five Plants (3+2)

This alternative included the application of nonstructural measures for the entire Urban Study Area in order to maintain per capita wastewater flows at the current levels. Flows would be reduced by an average of 7 mgd. Also, infiltration control for the City of Binghamton was assumed to further reduce flows by 4.5 mgd.

Of the five secondary facilities, the Binghamton-Johnson City, Endicott, and Chenango Valley would serve Broome County and the Town of Owego STP's No. 1 and 2 would serve Tioga County. The DO level in the Susquehanna River would be maintained above 5 mg/l except during occurrences of combined sewer overflows during certain storm conditions.

Alternative 12a: Secondary Treatment; Five Plants (2+3)

Of the five secondary sewage treatment plants, Binghamton-Johnson City and Endicott plants would serve Broome County and Town of Owego STP's No. 1 and 2 and Owego Village would serve Tioga County. This system was similar to the Baseline Condition except that Chenango Valley wastewater would be treated at the Binghamton-Johnson City facility and all plants would be expanded when needed to meet projected future flows. The objective of Alternatives 12a and 12b was to provide the minimum treatment necessary in order to maintain the DO in the Susquehanna River above 4 mg/l (except during periods of combined sewer overflows).

Alternative 12b: Secondary Treatment; Six Plants (3+3)

Alternative 12b was similar to 12a, with the exception that a separate treatment plant would handle flows from Chenango Valley rather than regionalize with the Binghamton-Johnson City facility. The DO level in the Susquehanna River would be maintained above 4 mg/l except during periods of combined sewer overflows.

Alternative 13: Secondary Treatment; Infiltration Control at Binghamton; Nitrification at Binghamton-Johnson City by 2000; Five Plants (3+2)

In this alternative, infiltration control for the City of Binghamton was assumed to reduce the average daily flow to the Binghamton-Johnson City plant by 4.5 mgd. The five secondary plants would be Binghamton-Johnson City, Endicott, and Chenango Valley serving Broome County, and Town of Owego STP's No. 1 and 2 serving Tioga County. In order to maintain the DO level in the Susquehanna River above 5 mg/l, nitrification would be required for Binghamton-Johnson City by the year 2000. Secondary treatment would be sufficient for the remaining facilities.

IMPACT ASSESSMENT

The major impact factors assessed for each alternative were divided into four major categories:

1. Aquatic Ecology
2. Terrestrial Ecology
3. Social Factors
4. Economic Factors

Each impact category was further divided into key questions or areas of concern.

A summary of the impact assessment for Stage II-2 alternatives is presented in Table V-13 at the end of this section. The major impact categories are discussed below.

Aquatic Ecology

Under the Baseline Alternative, treatment facilities would not be expanded to handle projected future sewage flows. The resulting overload at the sewage treatment plants would

reduce the quality of sewage effluent entering the Susquehanna River below secondary treatment standards. For each of the other "action" alternatives, facilities would be expanded and upgraded as necessary to maintain its objectives, i.e., 4 or 5 mg/l DO or zero discharge.

Dissolved Oxygen.

The minimum instream dissolved oxygen concentration which would be achieved was of concern both in terms of achieving NYSDEC standards and for maintaining a healthy aquatic ecosystem. Under existing conditions, except for combined sewer overflows, the minimum DO concentration in the Susquehanna River would be about 5 mg/l during MA-7-CD-10 flows. With the Baseline Alternative, increases in the oxygen demanding wastes entering the Susquehanna would result in a minimum in-stream DO concentration of 3.5 mg/l by the year 2020 during the MA-7-CD-10 flow (Figure V-9). The NYSDEC standards of 4 mg/l minimum daily, and 5.0 mg/l minimum daily average would not be met. The reductions of in-stream DO which would be experienced under the Baseline Alternative would adversely affect the aquatic biota of the Susquehanna River.

Alternatives 12a and 12b were designed to maintain the DO level in the Susquehanna River above 4 mg/l during dry weather conditions. (During wet weather conditions, the DO would drop below 4 mg/l under all the alternatives. Stormwater control alternatives are discussed in a later section of this chapter). Alternatives 2 through 5, 9 through 11, and 13, providing improved secondary treatment would maintain the DO level above 5 mg/l. Systems utilizing advanced waste treatment (Alternatives 6 and 7) and land treatment (Nos. 8a and 8b) would maintain a level above 6 mg/l, resulting in the largest beneficial impacts on aquatic ecology.

Nitrogen and Phosphorus.

Nitrogen and phosphorus nutrient loadings of wastewater, expressed at total N (lb/day) and total P (lb/day), were used to assess the potential of nuisance aquatic growth in receiving waters. These nutrient enrichment potentials were also used in assessing increased crop growths if secondary effluent was applied to the land (Alternatives 8a and 8b). None of the alternatives would result in serious problems with aquatic vegetation as discharges would be to freely flowing streams and rivers.

DISSOLVED OXYGEN PROFILES: EXISTING AND YEAR 2020 (MA-7-CD-10 FLOW)

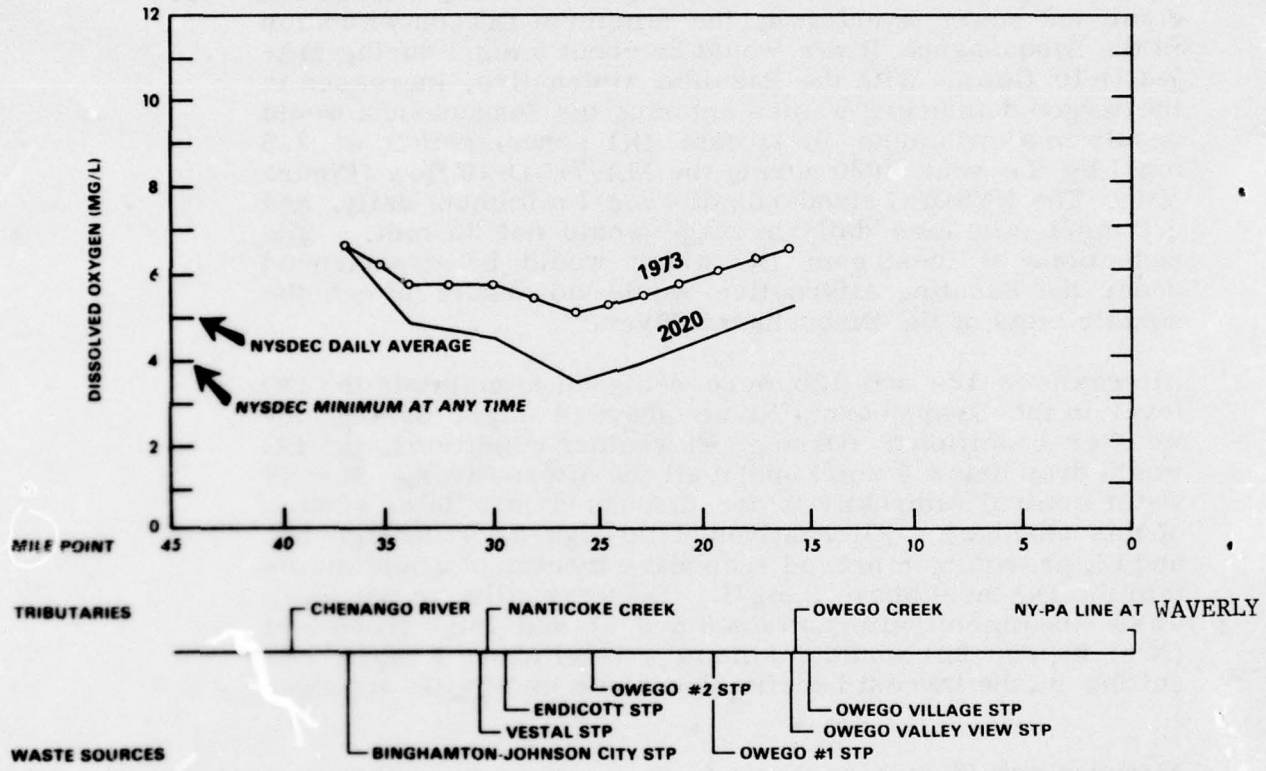


FIGURE V-9

Alternatives with the least amount of nutrient loadings were biological and physical/chemical advanced waste treatment (Nos. 6 and 7).

Ammonia.

The NYSDEC ammonia standard for fresh, surface waters of Class A, B, and C was based on the toxicity of un-ionized ammonia (NH_3) to fish. This standard required the concentration of NH_3 to be less than 2 mg/l at pH 8 or above. Assuming that effluent from STP's was the major source of ammonia in the river, an estimate of the in-stream concentrations of NH_3 in 1977 and for the year 2020 (under the Baseline Condition) were 1.21 and 2.06 mg/l, respectively. (The only other alternative that would violate the ammonia standard was No. 12a, providing secondary treatment, and resulting in a maximum NH_3 concentration of 2.02 mg/l.)

Construction Impacts.

A measure of temporary adverse impacts was the number of stream crossings required during pipeline construction. Increased sedimentation and turbidity could temporarily disrupt the aquatic ecosystem. Five major stream and river crossings would occur with regionalized systems providing only one treatment plant for Tioga County (Alternatives 2 and 3a), and for land treatment systems (Alternatives 8a and 8b). The remaining action alternatives required two such crossings while the Baseline Alternative had the least impact with only one stream crossing.

Terrestrial Ecology

The construction of any new sewage treatment facilities would require the utilization of some land area which is presently not developed. A gross measure of the reduction of such open space and its concomitant adverse impact upon present terrestrial ecology was the total number of acres required by a new facility. If constructed, the Chenango Valley plant would utilize about 5 acres near Broome Community College.

Land Treatment.

For Alternatives 8a and 8b, both beneficial and adverse impacts would result in the utilization of land for spray irrigation. Beneficial impacts upon terrestrial ecology could include: (1) phosphorus and nitrogen contributions from the wastewater effluent might enrich nutrient deficient soils and result in higher crop yields; (2) coliforms, a problem in receiving waters, would die-off in the soil matrix; (3) suspended organic solids would add to the organic matter of the soil and serve as a soil conditioner; and (4) a green belt of open space would be preserved against development. On the other hand, adverse impacts of spray irrigation of wastewater effluents could include (1) a build-up of heavy metal ions in the soil or in crops; (2) clogging of soil creating odors and health problems; (3) if improperly designed or operated, surface runoff to local streams, thereby contributing to erosion of land surfaces and pollution of surface waters; and (4) changes in vegetative cover and removal of some wildlife habitats.

Estimates of the total land requirements are presented in Table V-11. Application of flow reduction measures significantly reduces acreage requirements. The sites investigated and their pipeline routes from the treatment plants are shown in Plate 1.

TABLE V-11

ACREAGE REQUIREMENTS FOR LAND TREATMENT SYSTEMS
(YEAR 2020)

Sewage Treatment Plant	Alternative No. 8a Flow (mgd)	Alternative No. 8a Acres Required*	Alternative No. 8b Flow (mgd)	Alternative No. 8b Acres Required*
Binghamton-Johnson City	25.4	4,560	17.0	3,060
East Owego	2.8	504	2.3	414
West Owego**	2.4	432	1.95	351
TOTAL	30.6	5,496	21.25	3,825

*Includes 20% buffer zone.

**Includes 0.9 mgd from Owego Village.

Interceptor Sewers.

The extent of development which might be encouraged by extending sewerage services with its resulting reduction of natural terrestrial ecosystems was assessed by the number of miles of new sewer transmission lines which did not parallel existing roadways.

Higher degrees of regionalization were characterized by fewer treatment plants, thus requiring more miles of interceptors. The three plant system would need 7.2 miles of new interceptor while the four plant systems would require 5.8 miles if Tioga County had only one plant and 5.2 miles if each county had two STP's. Alternatives requiring the least amount of new sewers were six plant systems (2.8 miles). The five plant systems needed 3.8 miles if the Chenango Valley plant was built and 4.2 miles if not. Also, land treatment schemes required 6.7 miles of transmission main to transport effluent to the spray irrigation sites. In addition, to the above requirements, the 4 miles of interceptors to be constructed by 1977 under the Baseline Alternative would be included in all the alternatives.

Social Factors

Displacement.

A direct adverse socio-economic impact would be the displacement of homes and families as the result of construction and operation. The only alternative of concern was No. 8a, land treatment with no flow reduction. The large total land requirements for spray irrigation could require the displacement of about 80 families, particularly in Site No. 2 (see Plate No. 1) in the Towns of Binghamton and Conklin. The reduced land requirements for Alternative 8b, incorporating flow reduction measures, would probably not necessitate the relocation of any families.

Development.

Although the direction and degree of development in a particular area is a function of various factors, alignment and extent of sewer interceptors may influence development to some extent. Unrestricted extension of sewers in the Baseline Plan may result in some undesirable development based on the Southern Tier East Region General Plan. The

construction of an interceptor from West Owego to the East Owego STP, in Alternatives 2 and 3, could encourage undesirable development along a particularly scenic part of the Susquehanna River between Appalachin and Hiawatha Island. Methods for restricting development such as flood plain zoning, other local zoning ordinances and building permit regulations could help to limit sprawl.

Commitments of large areas for spray irrigation in Alternatives 8a and 8b within the Towns of Binghamton and Conklin would not interfere with regional plans but may not conform to local land use and development patterns. Any induced development from the remaining alternatives would not conflict with the Southern Tier East Region General Plan.

Historic and Archeological Sites.

Construction and operation of the alternatives would not affect any known historic sites. However, the Susquehanna and Chenango River Valleys have archeological significance and any construction in the valleys could disturb these sites. In this iteration, no specific sites of archeological importance were known, and therefore, the extent of any impacts to archeological resources from construction of a wastewater management system was uncertain. A detailed cultural resources reconnaissance was conducted in a later iteration.

Recreation.

Disturbances to recreational facilities would temporarily occur during construction of sewer lines. The number of recreational facilities disturbed increases with increasing degrees of regionalization, i.e., two facilities disturbed with six plant schemes, three with five plant schemes, four with four plant schemes, and five with three plant schemes. Transmission lines to land treatment sites would temporarily disrupt one additional recreational facility. No recreational facilities will be disturbed by construction of interceptors for the Baseline Alternative. Construction of a separate Chenango Valley STP could cause odor problems, if improperly operated, for users of the Route 81 River Park.

Although there are short term construction impacts on recreational facilities associated with the action alternatives, the long term aesthetic and recreational potential of the

rivers would be improved over that of the Baseline Condition. Local water quality objectives for improvement of recreational resources would be enhanced under any of the action alternatives.

Construction Impacts.

Short term construction impacts, particularly dust, noise, and traffic interruptions would temporarily inconvenience the population. The number of miles of interceptors and other pipelines (e.g., transmission lines to land treatment sites) which would be constructed along existing roadways was a measure of the magnitude of such adverse impacts. Alternatives having the greatest impact in this category were Nos. 8 (a and b), 2, 3a and 3b, with 8.3, 5.7, 4.8, and 3.5 miles of pipe, respectively, along existing roads. Alternatives with a lesser degree of regionalization and not employing land application systems, would not have as great an impact along roadways. Six plant regionalization systems would have the least impact, requiring 1.3 miles of new pipeline along existing roadways. Five plant systems with three STP's in Broome County required 2.5 miles of pipe while five plant systems with three STP's in Tioga County required 2.2 miles of new interceptors. For all alternatives, these pipelines are in addition to 4.5 miles of new interceptors to be constructed by 1977 under the Baseline Alternative.

Public Health

A primary concern of any wastewater management scheme was the reduction in potential health hazards. Under the Baseline Alternative, existing malfunctions and overflows of septic systems in the Chenango Valley area would continue to represent a public health hazard to area residents. Also, combined sewer overflows in the Urban Study Area would continue to have adverse impacts in terms of public health and recreational potential of the Susquehanna and Chenango Rivers in addition to constituting illegal discharges of raw sewage. Any of the action alternatives, in conjunction with a stormwater control plan, would mitigate these adverse public health impacts.

A possible adverse affect on public health from spray irrigation of wastewater was the dispersal of virus via aerosols. Therefore, to minimize any such adverse affects, spray

irrigated areas in Alternatives 8a and 8b would be at a minimum distance of 00 feet from any areas of human activity (i.e., homes, roads, businesses, schools). Another possible adverse impact to public health could be created if ponding and stagnation on soil surfaces occurred during spray irrigation. Finally, surface runoff of spray irrigated wastes could pollute streams, impoundments, or underground waters. Application rates should be based on soil and crop characteristics to prevent such ponding and runoff. Chapter V of the Specialty Appendix discusses in more detail the aspects of land application.

Economic Factors

Table V-12 presents a comparison of economic factors of alternatives from local, regional, and Federal viewpoints. One number which was used to compare the total cost of alternatives was the present worth of all expenditures. The present worth of local expenditures of a particular alternative indicated the total cost of that alternative to the region over the economic life of the project (to 2027). The local share is estimated to be 12. percent of the capital costs plus 66.7% of the yearly operation and maintenance costs.

The minimum and maximum per family annual payments, shown in dollars per family per year, indicated the range of costs a family (3 to 5 persons) could expect to pay if a particular alternative was implemented.

The wide difference in minimum and maximum yearly costs for the advanced waste treatment and land application systems occurred as the lower cost represented payments prior to construction of these systems in 1985 the higher costs were associated with construction and operation after 1985. All costs were in addition to present expenditures and family payments. A summary of the impact assessment for Stage II-2 alternatives is presented in Table V-13.

TABLE V-12

ECONOMIC FACTORS
STAGE II-2 ALTERNATIVES

Alternative	Total Present Worth Million $	Local Share Present Worth Million $	Per Family Minimum $/yr	Annual Payments Maximum $/yr**
1	33.0	24.0	12.50	15.00
2	48.6	29.7	14.50	16.50
3a	52.0	31.4	15.00	18.00
3b	46.6	29.5	14.50	16.50
4a	49.0	32.0	15.50	18.50
4b	46.6	30.1	14.50	17.00
5	49.0	31.8	15.50	18.00
6*	103.0	60.1	15.50	43.00
7*	104.0	63.5	12.50	51.00
8a	71.0	40.8	15.50	25.00
8b*	55.0	32.3	15.00	19.00
9*	41.6	27.4	14.00	15.50
10	59.0	35.5	15.50	22.00
11*	40.0	27.4	12.50	15.50
12a	41.6	27.6	13.50	15.50
12b	45.0	29.4	14.50	16.50
13*	45.4	29.3	15.00	16.00

*Does not include costs of infiltration control on non-structural measures.

**All costs are in addition to present expenditures and family payments.

SELECTION OF ALTERNATIVES FOR FURTHER STUDY

Evaluation and Screening

As occurred near the end of each iteration, the management and advisory committees met again at the completion of Stage II-2 to evaluate and screen the 13 alternatives. Those recommended were carried forward to the final stage of the Study. The concerns and value judgements of the committees are documented in the following paragraphs.

Alternative 1, the Baseline Condition, represented essentially existing conditions and provided a basis against which the impacts of other alternatives could be compared. This alternative was evaluated throughout the Study.

Alternatives 2 and 3a included only one treatment plant to serve Tioga County. The terrestrial ecology and social impacts, especially those impacts associated with the construction of an interceptor from West Owego to East Owego, were less desirable than alternatives achieving similar water quality objectives without this long interceptor. Therefore, neither alternative was recommended.

Alternatives 3b, 4a, 4b, and 5 all provided nitrification at Binghamton-Johnson City, but differed in the degree of regionalization. As the impacts associated with 4, 5, or 6 plant systems were not refined sufficiently in this Stage to select one scale of regionalization over another, they were all investigated in Stage III. Alternatives 3b (2 plants in Broome and 2 in Tioga) and 5 (3 plants in each county) were recommended in order that all treatment plant schemes would receive further consideration and the optimal degree of regionalization for each county could be determined.

Alternatives 6 and 7 provided for the application of advanced waste treatment. Alternative 6 included biological based treatment while alternative 7 used physical/chemical (P/C) processes. The present worth of the total capital, O & M, and replacement costs for biological and P/C systems were not significantly different for the larger scale facilities (Binghamton-Johnson and Endicott). For smaller scale facilities (Chenango, Owego STPs No. 1 and 2), the P/C systems were less expensive.

The P/C system would consume more chemicals than the biological system, and the sludge produced would have less

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IMPACT ASSESSM
STAGE II

Impact Indicators	1 1977 Baseline Condition	2 3 STP's Nitrification at B-JC	3A 4 STP's (3+1) Nitrification at B-JC	3B 4 STP's (2+2) Nitrification at B-JC	4A 5 STP's (3+2) Nitrification at B-JC	4B 5 STP's (2+3) Nitrification at B-JC	5 6 STP's Nitrification at B-JC	6 5 STP's BIOL. AWT I-Control at B-JC
Ecological								
1. DO mg/l	3.5	5.4	5.4	5.4	5.4	5.4	5.4	6.7
2. Total N (lb/day)	6830	7540	7540	7540	7540	7540	7540	625
3. Total P (lb/day)	1740	1880	1880	1905	1905	1905	1905	555
4. Ammonia mg/l	2.06	1.14	1.12	1.14	1.12	1.14	1.12	0.18
5. No. major stream crossings	1	5	5	2	2	2	2	2
6. Acreage for new STP	0	0	5	0	5	0	5	5
7. Miles of new regional interceptor not along existing roadways	4.0	11.2	9.8	9.2	7.8	8.2	6.8	7.8
8. Other acreage used for waste-water treatment (spray irrigation)	0	0	0	0	0	0	0	0
9. Other miles of pipeline (to spray irrigation sites) not along existing roadways	0	0	0	0	0	0	0	0
Social								
1. No. families displaced	0	0	0	0	0	0	0	0
2. Result in desired development patterns	May or May not	No	No	Yes	Yes	Yes	Yes	Yes
3. Miles of new regional interceptors along existing roadways	4.5	10.2	9.3	8.0	7.0	6.7	5.8	7.0
4. Miles of other pipelines along existing roadways	0	0	0	0	0	0	0	0
5. No. recreational places disturbed	0	5	4	4	3	3	2	3
6. Improve recreational potential of Rivers during non-storm periods	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes Yes
7. Reduce potential health hazard	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. No. historic sites distrubed	0	0	0	0	0	0	0	0
Economic								
1. Present worth of all expenditures ($ Millions)	33	48.6	52	46.6	49	46.6	49	103
2. Present worth of local expenditures ($ Millions)	24.0	29.7	31.4	29.5	32.0	30.1	31.8	60.1
3. Minimum per family annual payment ($)-Year	12.44-2026	14.35-2026	15.13-2026	14.27-1982	15.45-2025	14.61-1982	15.59-2026	15.28-1982
4. Maximum per family annual payment ($)-Year	14.95-1977	16.63-1991	17.76-1983	16.74-1983	18.35-1983	17.08-1983	17.93-1983	42.99-1985

(s) - summer, (w) - winter

*7540 (W) – Alternative 8A, 7540 (W) – Alternative 8B
**1905 (W) – Alternative 8A, 1905 (W) – Alternative 8B

TABLE IV-13

IMPACT ASSESSMENT SUMMARY, YEAR 2020
STAGE II-2 ALTERNATIVES

6	7	8A	8B	9	10	11	12A	12B	13
5 STP's BIOL. AWT I-Control at B-JC	5 STP's P/C AWT I-Control at B-JC	5 STP's Applied to Land	5 STP's Applied to Land, Flow Reduced	5 STP's Non-Structural & Nitrification at B-JC Measures	5 STP's Nitrification at all STP's	5 STP's Non-Structural + I-Control	5 STP's (2+3) All Secondary	6 STP's All Secondary	5 STP's Nitrification + I-Control at B-JC
6.7	6.7	6.3	6.3	5.5	6.1	5.1	4.4	4.7	5.6
625	625	2970(S)*	2970(S)*	7540	7540	7540	7540	7540	7540
555	125	765(S)**	765(S)**	1905	1905	1905	1905	1905	1905
0.18	0.18	0.87	0.87	1.08	0.41	1.67	2.02	1.67	1.08
2	2	5	5	2	2	2	2	2	2
5	5	5	5	5	5	5	0	5	5
7.8	7.8	7.8	7.8	7.8	7.8	7.8	8.2	6.8	7.8
0	0	5496	3825	0	0	0	0	0	0
0	0	1.5	1.5	0	0	0	0	0	0
0	0	80	0	0	0	0	0	0	0
Yes	Yes	May or May not	May or May not	Yes	Yes	Yes	Yes	Yes	Yes
7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.7	5.8	7.0
0	0	5.8	5.8	0	0	0	0	0	0
3	3	4	4	3	3	3	3	2	3
Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
0	0	0	0	0	0	0	0	0	0
103	104	71	55	41.6	59	40	41.6	45	45.4
60.1	63.5	40.8	32.3	27.4	35.5	27.4	27.6	29.4	29.3
15.28-1982	12.38-1982	15.28-1982	14.96-1984	13.76-2026	15.28-1982	12.64-2026	13.50-2026	14.40-2026	14.94-2026
42.99-1985	50.91-1985	25.21-1985	18.90-1985	15.47-1977	21.74-1983	15.50-1977	15.32-1983	16.73-1992	16.00-1983

potential for recycle. However, the P/C system had the advantage of being more resistant to toxic industrial wastes and to shock loads during storm conditions; and also had the advantage of requiring less space. The last two advantages would be particularly important for treatment plants with limited space for expansion or subject to excessive wastewater flows during wet weather conditions. Thus, further investigation of both systems was required to enable the selection of an optional advanced waste treatment system.

Alternatives 8a and 8b provided for seasonal land treatment with the latter employing flow reduction measures to reduce land requirements. Due to the seasonal approach to advanced waste treatment, direct comparison (with year-round effluent quality) to other AWT alternatives was not possible. However, some useful information could be obtained if the cost of implementing seasonal land application was compared to an AWT system. The cost of the land treatment system was less than AWT at Binghamton and Owego STP No. 2. At Owego STP No. 1, land application was more expensive than the P/C AWT and not significantly different from the biological system. A comparison between the two land application alternatives indicated the large land requirements and possible adverse social impacts of Alternative 8a, making it less desirable than Alternative 8b. The latter system, employing flow reduction measures, was selected for further consideration by the CAC. The TAC believed however, that land treatment alternatives should be dropped altogether due to the high cost and large land requirements without compensating water quality benefits in comparison to the AWT systems (operated throughout the year). The ISMG agreed with the CAC and recommended seasonal land treatment with flow reduction measures to be further investigated.

Alternatives 9, 10, 11, and 13 employed infiltration control and/or nonstructural measures. Flow reduction measures resulted in significant cost savings and were environmentally desirable. The application of these measures was recommended although, at this iteration, estimated costs and success of these measures were not known. Althernative 11, which employed both infiltration control and nonstructural flow reduction measures was recommended because it would require the least amount of treatment to maintain river DO levels above 5 mg/l. It was also more environmentally acceptable because of the lower energy and chemical requirements and less dependence upon treatment processes (i.e., did not require a nitrification process as in the other alternatives).

Alternatives 12a and 12b were designed to provide the minimum treatment necessary to maintain river DO levels above 4 mg/l. The five plant scheme (2+3) in 12a was less expensive than the six plant scheme in 12b and was, therefore, recommended for further evaluation.

Recommended Alternatives

Based on these concerns of the management committees, 8 alternatives were recommended for detailed planning in Stage III. The alternatives developed for Stage II-2 and the recommendations for Stage III are displayed in Table V-14.

TABLE V-14

STAGE II-2
ALTERNATIVE DESCRIPTIONS AND RECOMMENDATIONS

Alternative	Description
*1	1977 Baseline Condition
2	Three plants (2+1) with nitrification at Binghamton-Johnson City STP
3a	Four plants (3+1) with nitrification at Binghamton-Johnson City STP
*3b	Four plants (2+2) with nitrification at Binghamton-Johnson City
4a	Five plants (3+2) with nitrification at Binghamton-Johnson City
*5	Six plants (3+3) with nitrification at Binghamton-Johnson City
*6	Biological AWT - Five plants (3+2) *Infiltration control at Binghamton*
*7	Physical/Chemical AWT - Five plants (3+2); Infiltration control at Binghamton
8a	Seasonal land application - Five plants (3+2)
*8b	Seasonal land application - Five plants (3+2); Nonstructural measures and infiltration control at Binghamton
9	Five plants (3+2) with application of nonstructural measures; nitrification at Binghamton-Johnson City
10	Five plants (3+2) - Nitrification at all plants; infiltration control at Binghamton
*11	Five plants (3+2) - Nonstructural measures; infiltration control at Binghamton

*Recommended Alternatives for Stage III.

TABLE V-14 (Continued)

Alternative	Description
*12a	Five plants (2+3) all secondary
12b	Six plants (3+3) all secondary
13	Five plants (3+2) - Infiltration control at Binghamton; nitrification at Binghamton-Johnson City

*Recommended Alternatives for Stage III

STORMWATER MANAGEMENT

INTRODUCTION

Stormwater runoff is the excess water running off from the surface of a drainage area during and immediately after a period of rain. Most of the water enters the sewage system and is conveyed to a treatment plant or to sewer outfalls where it is discharged directly to the river. Stormwater is contaminated by the wastes from streets, roofs, lawns, and sidewalks, and therefore, pollutes receiving streams and rivers.

Storm runoff may cause problems in both rural and urban areas. Erosion and flood problems may result from improper management and water quality problems may stem from pollutants carried by storm runoff to streams. Expanding urbanization causes an increase in both the quantity of storm water runoff and the pollutant levels in that water.

Storm runoff is handled by either of two types of sewage systems - separate or combined. In a separate sewer system, storm runoff is carried by pipes designed only for that purpose. Discharge is generally to a stream or river with little or no treatment of wastes. Sanitary wastes are carried in a separate pipe to a sewage treatment plant (STP). In a combined sewer system, the sewer handles municipal, industrial, and storm runoff flows in the same pipe which leads to a STP. When a combined sewer system is overloaded by stormwater and/or infiltration, the STP is bypassed and raw wastewater from domestic and industrial sources as well as stormwater runoff is discharged directly to receiving waters such as the Susquehanna River. These combined sewer overflows can result in serious water pollution and health hazard problems.

Public Law 92-500 places strong emphasis on the control of urban runoff. Section 212(2)(b) mentions preventing, abating, reducing, storing, treating, separating, or disposing of stormwater runoff in municipal wastewater systems where such methods are cost-effective. Rules and regulations for construction grants for wastewater treatment facilities require all applicants for grant assistance to demonstrate that each sewer collection system is not subject to excessive infiltration/inflow. (Construction Grants for Waste Treatment Works, 1974.)

In many instances, wastewater management plans that are based only on dry weather conditions will be ineffective in achieving water quality levels comparable with the intended uses of the river. Thus, stormwater management plans complement dry weather flow management plans in achieving water quality goals.

This Study was concerned with the water quality management problems in the urban areas of Broome and Tioga Counties. Local government and planning boards of the two counties have indicated their concern for urban stormwater runoff problems in the region. In the following sections, the storm runoff problems and their water quality impacts are investigated. Feasible urban stormwater control alternatives and their interaction with wastewater management alternatives are then discussed for the City of Binghamton.

STORMWATER RUNOFF PROBLEMS

Alternative management schemes for wastewaters generated from domestic and industrial waste sources were previously discussed. These alternatives were concerned with water quality control during dry weather flow conditions. During periods of storm inflow or high infiltration rates, the wastewater flows in the combined sewer system can exceed the capacities of the Binghamton area treatment facilities and significant pollution loads could be discharged to the Susquehanna River. This, in most cases, would render wastewater management alternatives that are based only on dry weather conditions ineffective in achieving water quality objectives during storm conditions. Thus, storm runoff management alternatives complement the dry weather flow management alternatives in obtaining water quality levels compatible with stream standards and the intended uses of the river.

A recent drainage and stormwater runoff study (Shumaker and Hawk, 1974) was performed for the Southern Tier East Regional Planning Board. Existing major drainage and stormwater problems throughout the area were catalogued and future problems under project conditions were discussed.

Shumaker and Hawk divided the two counties into planning basins. The City of Binghamton planning basin was found to have erosion problems along both large and small creeks

and problems of overflows associated with the existing combined storm and sanitary sewer system. This basin was recommended for further study in the master planning stages because of the existing and anticipated future storm drainage problems.

In the Endicott area, the major problems identified by Shumaker and Hawk were channel erosion in the Village of Endicott along Brixius Creek and roadway flooding on Country Club Road. They recommended that efforts should be directed toward systematic maintenance of existing facilities. Among these facilities are two Soil Conservation Service dams protecting most of the Endicott area from flooding. They also recommended that steps be taken to preserve flood plains through proper planning and zoning actions.

For the planning basin that included the Village of Owego, Shumaker and Hawk found that the existing drainage problems included flooding of Owego Creek in the Village. Future problems in storm drainage were found to be likely along Owego Creek unless preventative measures are taken in upstream planning basins or additional corrective measures are taken in the downstream areas. Local problems were found to be probable because of the projected future urbanization for all sides of the Village of Owego according to the General Plan. They recommended that efforts should be made toward further stabilization of the Owego creek channel and systematic maintenance of existing drainage facilities. Also, it was recommended that new development be prohibited from encroaching on flood plains.

Shumaker and Hawk also reviewed alternative methods for the correction of drainage and stormwater problems. These methods included the reconditioning or replacement of unsatisfactory drainage facilities, the enlargement of existing systems, provision of additional drainage systems, multiple use of existing upstream storage sites and land use controls. They concluded that the optimum solution for drainage problems would consist of an economic choice between the different combinations of the above systems. To achieve an economical and effective solution, planning on the regional level was recommended.

The Shumaker and Hawk study also recommended the preparation of a Criteria Manual for the orderly and consistent design of storm drainage systems and the detailed master planning of selected basins on a priority list. The possibility of multiple use of county regional park sites as stormwater retention facilities was highlighted.

Combined Sewer Overflows

As mentioned, serious water quality problems could result from storm runoff in areas served by combined sewer systems. Within the study area, a portion of the Binghamton-Johnson City area and the Village of Owego are currently served by combined sewers. The Endicott area is mainly served by separate sanitary and storm sewers as is the Town of Owego. Examination of the sewer maps showed about 85 percent of the total area is served by separate storm and sanitary sewers. Table V-15 presents the percentage of combined and separate sewers in the existing service areas.

A study was also prepared for the Village of Owego (K. G. Woodward and Associates, 1968), recommending the separation of storm and sanitary sewer systems. New York State has requested that work be initiated to achieve this objective in the Village.

TABLE V-15

EXISTING SEWERAGE SYSTEMS

Service Area	Type of Sewers	Population Served
Binghamton-Johnson City	Combined-70% Separate-30%	102,000
Vestal	Separate-100%	7,500
Endicott	Combined-15% Separate-85%	44,700
Owego STP No. 1	Separate-100%	600
Owego STP No. 2	Separate-100%	6,500
Owego Village	Combined-65% Separate-35%	3,600
Owego Valley View	Separate-100%	500
Total Study Area	Combined-15% Separate-85%	165,400

Existing and future wastewater flows from the Owego Village area are significantly less than those from the Binghamton-Johnson City area. The existing average wastewater flow in the former area was less than 1 mgd as compared to 18.25 mgd for the latter area. Thus, it is expected the storm overflow pollution load to the Susquehanna River that could occur in the Binghamton-Johnson City area is much greater than the corresponding pollution load from the Owego Village area. Conferences with local governments and planning boards of Broome and Tioga Counties, NYSDEC, and EPA officials indicated storm runoff and combined overflows from the City of Binghamton is a problem of major concern. The area has the largest population in the two county area and is served by a fairly old combined sewer system. The recently completed secondary wastewater treatment facility for the Binghamton-Johnson City area was planned to be a regional facility to handle wastewater flows from surrounding urban areas. Due to infiltration/inflow problems, the plant may not be capable of serving these adjacent areas. The major trunk and interceptors of the existing sewer system in the City of Binghamton are shown in Plate 2. The Binghamton sewer system was found to be subject to significantly higher flow rates during wet weather conditions. The combined sewer system overflows to the Chenango and Susquehanna Rivers during these excessive flows, resulting in the discharge of raw sewage (up to 50% of the sanitary flow) to the waterways. The purpose of the Shumaker Study (1974) mentioned eariler was to define the sources of these higher flows and to outline possible correctional measures. The Village of Johnson City has also been directed to undertake an analysis and evaluation of its sewer system.

For these reasons, and because the consulting firm of Shumaker Engineers performed a concurrent infiltration/inflow analysis for the City of Binghamton, most of the effort for stormwater control management was expended in developing alternatives for the Binghamton area. Later in the Study, the measures developed for stormwater management in the City of Binghamton were applied to the Village of Owego to help solve its overflow problems.

National Pollutant Discharge Elimination System (NPDES) Permits

According to the requirements of the NPDES special permits for combined sewer overflows and/or bypasses, an overflow

management program "...would eliminate or significantly reduce pollution from these sources so as to maximize the achievement of water quality standards." It should be noted here that the emphasis is to achieve water quality standards. Secondly, it is recognized that elimination of overflow pollution may prove to be uneconomical and hence, significant reduction in the load may be more practical than complete elimination.

The NPDES permits also require a final plan describing the overflow management program. This plan should include the evaluation of the following measures:

1. Dual use treatment facilities.

2. Storing and/or treating initial or final sewer system flushes.

3. Storage and subsequent treatment of discharges.

4. Improvements in the sewer system.

APPLICATION OF STORMWATER MODELS

The analysis of the storm overflow problems indicated the significance of overflow pollutant magnitudes. Because of the lack of direct measurements of urban runoff, infiltration and overflows, it was felt a comprehensive analysis utilizing mathematical and digital computer simulation models was warranted. The models provided a more accurate estimate of stormwater quantity and overflow volume and pollutant magnitudes. Also, the models were valuable in evaluating the effectiveness of alternative combined overflow management systems.

Two computer programs were utilized. The first was the Storm Water Management Model (SWMM) developed by the Environmental Protection Agency (Metcalf and Eddy, 1971). This water quality model was used to estimate overflow volume and pollutant (BOD & NOD) loadings from the Binghamton sewer system. In evaluating the impacts of overflows on the DO level of the river, it was necessary to use a model simulating the dynamic conditions of stormwater overflows. For this reason, Receive II, also developed by EPA, was used.

Design Storm

As input to the SWMM, the frequency of occurrence of various rainfall intensities was analyzed to determine the appropriate design storm. Previous studies indicate it is not economical to design the control measure to handle the most critical storm as most of the pollution load is discharged with the initial overflow flushes. Hence, to completely eliminate these direct discharges is not economically feasible or necessary.

Rather, the design storm was based on the following criteria: (1) the frequency occurrence of various storms during low flow periods (design river flow) when background DO levels are low; (2) the number of summer days (April to September) the Susquehanna and Chenango Rivers would not be safe for swimming due to overflows from storms exceeding a given rainfall.

The storm selected for the design of overflow control facilities was 1.25 inches per day. Storms equalling or exceeding this value have occurred only twice during the design river flow in 30 years of records and would result in unsafe swimming conditions an average of six days every April-September period.

Design River Flow

The design river flow was utilized in the Receive II model to determine the effects of combined sewer discharges during low river flow periods. The occurrence of local rainstorms during periods of low river flow can decrease the dissolved oxygen to levels harmful to aquatic life. Water quality standards are based on the minimum average seven consecutive day flow expected once in ten years (MA-7-CD-10). This flow, 330 cfs in the Susquehanna River at Vestal, was used in designing treatment levels for sewage treatment plants. However, as there are no State standards for the design of stormwater control facilities, and as overflows occur only periodically, the minimum average seven consecutive day flow occurring every year (MA-7-CD-01) was believed to be a more appropriate basis for design. The average MA-7-CD-01 flow at Vestal is 600 cfs and was used as the design river flow for the Receive II model.

In summary, the SWMM program computed the volume and pollutant load (BOD and NOD) of combined sewer overflows resulting from a 1.25 inches/day storm. This pollutant load was then added to the effluent load from the Binghamton-Johnson City treatment plant to estimate their effect on DO levels during low river flow (600 cfs) conditions. A more detailed description of the selection of both the design storm and design river flow is contained in Chapter VII of the Design and Cost Appendix.

OVERFLOW CONTROL ALTERNATIVES FOR THE CITYOF BINGHAMTON

The control measures considered included both storage and treatment. The required capacities associated with these control measures were based on the overflow volumes and rates as estimated by the Storm Water Management Model. Cost data for these storage and treatment facilities and the effectiveness of these alternatives in controlling overflows is discussed. An alternative to either storage or treatment, sewer system separation, was initially considered. Due to the prohibitive high cost and inconvenience to the public as described in the Shumaker I/I Study performed in 1974, sewer system separation was dropped from further investigation.

The effectiveness of other combined overflow control alternative was measured by both the percentage reduction in the long-term overflow pollution load (level of treatment) and by the ability to prevent direct discharges of overflows resulting from larger storms (system capacity). The latter measure is related to the selection of the "design storm." The alternatives discussed below were all based on the same "design storm" defined as 1.25 inches of rainfall in 24 hours. The overflow control alternatives were sized not only to handle combined sewer overflows but also the increased flow to the Binghamton-Johnson City Sewage Treatment Plant as a result of the design storm. This would reduce the need for the treatment plant to be bypassed (with untreated flows discharged directly to the river), particularly when future service area expansion results in increased flows.

Proposed Alternatives

Four alternative control measures for the City of Binghamton's combined sewer overflow problems were developed and evaluated.

The control structures were designed to handle the overflow volume and the amount of increased flow occurring at the treatment plant as a result of the design storm. The four stormwater management alternatives were:

1. Storage and subsequent treatment at Binghamton-Johnson City Sewage Treatment Plant, designated A.

2. Treatment at overflow sites using micro-strainers, designated B.

3. Treatment at overflow sites using dissolved air flotation, designated C.

4. Centralized treatment using a modified biological process, designated D.

Chlorination facilities were included in all the alternatives for disinfection.

In the following sections, the description of the location, the capacity and the main characteristics of the facilities required for each storm overflow management scheme are summarized and effectiveness of each alternative is discussed. One measure of the system effectiveness was its ability to achieve dissolved oxygen levels compatible with those required by the water quality standards. Another measure was the ability to reduce the pollution loads to the Susquehanna River. The load reduction was evaluated in the short term as well as in the long term. The "short term" evaluation reflects the reduction of the shock load due to the storm event, i.e., immediately following a given storm. The "long term" reflects the total load reduction due to the typical storms that may occur in the April through September period.

Finally, cost estimates of each alternative are summarized. This includes the capital, operation and maintenance, and annual costs. Also, a unit cost analysis was performed in order to compare the cost-effectiveness of the storm overflow control alternatives to those of the dry weather wastewater management alternatives.

Alternative A - Storage and Subsequent Treatment at Existing Treatment Plant.

General. Storage basins may be built near the locations where combined sewer overflows are discharged or near major sewers that carry substantial flows during wet weather conditions. During these high sewer flow conditions, overflows would be diverted to the basins. After the storm subsides, the stored wastewater would be released to the existing Binghamton-Johnson City sewage treatment plant during periods of low sanitary flow. This would reduce the peak flows at the plant, and thus, might delay required expansion of facilities due to projected wastewater flow increases. Also, equalizing the flow rates could improve the efficiency of the wastewater treatment processes.

It is advantageous to have the storage basins as close as possible to the main interceptors in order to save the transmission costs to and from these basins. The exact location of the overflow storage basins would be influenced by land availability. It may prove infeasible to build a storage basin at a specific overflow site. In this case, it could be possible to build the basin further upstream in the sewer system or build a transmission line from the overflow point to the available storage site.

The cost of building a storage facility, of a given size, is highly dependent on local conditions such as land availability and costs, groundwater conditions, soil, type of storage facility, and local construction costs. It is possible to build a storage facility under or above the ground surface and the choice between these two types depends on economic and environmental impacts of each. In the analysis, the cost was based upon that of a covered concrete storage facility built with its top at ground level.

The effectiveness of the storage alternative in reducing the combined overflow pollution loads was determined by the removal efficiencies of the existing Binghamton-Johnson City treatment facility. Thus, this alternative could achieve a combined overflow effluent quality characteristics identical to those of secondary effluent.

Main Characteristics. In this scheme, combined overflows could be stored in five storage basins located as shown in Figure V-15, near the overflow sites. Each storage basin was designed to contain the stormwater runoff volume from the design storm mentioned earlier of 1.25 inches in a 24 hour period. These volumes were defined using a modified version of the Storm Water Management Model (SWMM). A

flow diagram for the storage basin facility is shown in Figure V-10.

The system operates such that the combined sewer flow would be directed to the storage basin following the storm occurrence. The stored volume would be released from the basin in the following days during dry weather flows (municipal wastewater) utilizing the diurnal variation in sanitary flow.

Effectiveness.

1. The minimum instantaneous DO level during the design storm (1.25 inch/day) would be between 5 mg/l and 6 mg/l in conjunction with any of the dry weather wastewater treatment alternatives.

2. Reduction of pollution loads due to combined sewer overflows would result.

a. Short Term (reductions per storm).

BOD Load Reduction = 10,160 lbs.

NOD Load Reduction = 6,200 lbs.

Coliform - reduce effluent total count to 1,000/100 ml.

b. Long Term. This alternative would reduce the BOD pollution discharged to the Susquehanna River by an average of 225,000 pounds during a typical summer (April-September) period. This reduction would be equivalent to 42 percent of the current 3,000 lb/day daily effluent BOD load from Binghamton-Johnson City Sewage Treatment Plant (STP). It would also reduce the NOD load discharged to the Susquehanna River by an average of 75,000 pounds during a typical summer period. This reduction would be equivalent to 8 percent of the current 5,200 lb/day discharged in the secondary effluent of the STP.

Cost. The cost of construction of each basin is summarized in Table V-16 and includes the following items: an aeration system to prevent odor problems, a solids removal system, and a chlorination system to treat overflows including those exceeding the storage capacity. The total capital cost for this system would be $22,200,000 with annual operation costs of $240,000 for an annual average cost of $1,930,000.

ALTERNATIVE A

STORAGE TANKS FLOW DIAGRAM

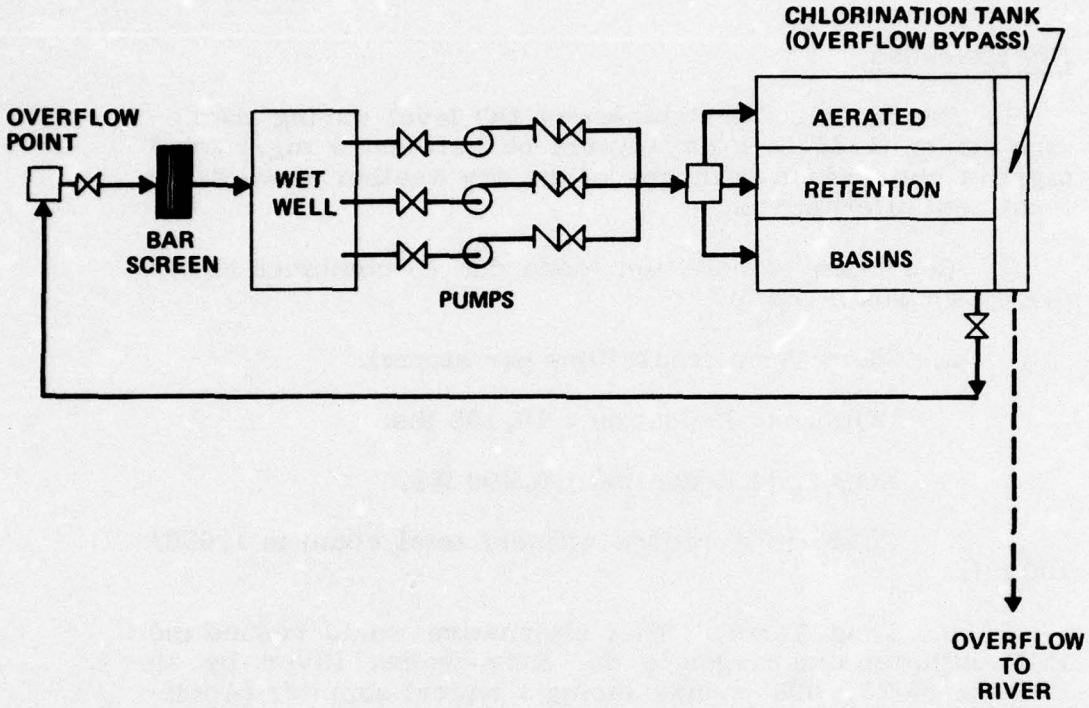


FIGURE V-10

TABLE V-16

ALTERNATIVE A
STORAGE BASIN CAPACITIES AND COSTS

Overflow Point (Fig. V-15)	Required Volume (mg)[1]	Overflow Basin Volume (mg)[1]	Construction Cost	O & M $/year
1	13.2	13	$7,000,000	$68,000
2	7.7	8	5,100,000	59,000
3	3.0	3	2,800,000	35,000
4	4.9	5	3,943,000	40,000
5	4.0	4	3,350,000	38,000
	32.8	33	$22,193,000	$240,000

[1] Million gallons.

Alternative B - Treatment at Overflow Sites Using Micro-Strainers.

Main Characteristics. *Microstrainers or microscreens* are essentially mechnical filters on a rotating drum. The filter is usually a tightly woven wire mesh fabric fitted on the drum periphery. The drum is placed in a tank and wastewater flows through the rotating screen on the drum. The filtered solids are continuously backwashed off the screen and removed from the inside of the drum. A schematic of a typical microstrainer is shown in Figure V-11. Five treatment facilities, ranging in capacity between 6.5 to 10 mgd would be located at the sites shown in Figure V-15. A flow diagram for the microstrainer suggested in this alternative is shown in Figure V-12.

Effectiveness.

1. The minimum instantaneous DO level during the design storm (1.25 inch/day) would be between 4 and 5 mg/l in conjunction with secondary or improved secondary treatment of wastewater. In conjunction with AWT or land treatment systems, the minimum instantaneous DO level would be 5 to 6 mg/l.

2. A reduction in pollution loads due to combined sewer overflows would be achieved.

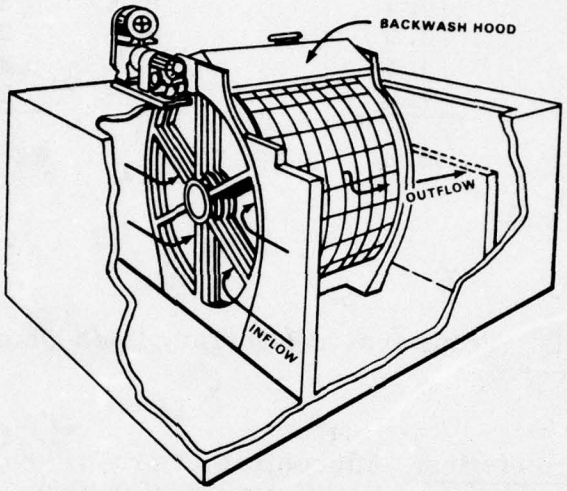


FIGURE V-11 Microstrainer

ALTERNATIVE B: MICROSTRAINER SYSTEM FLOW DIAGRAM

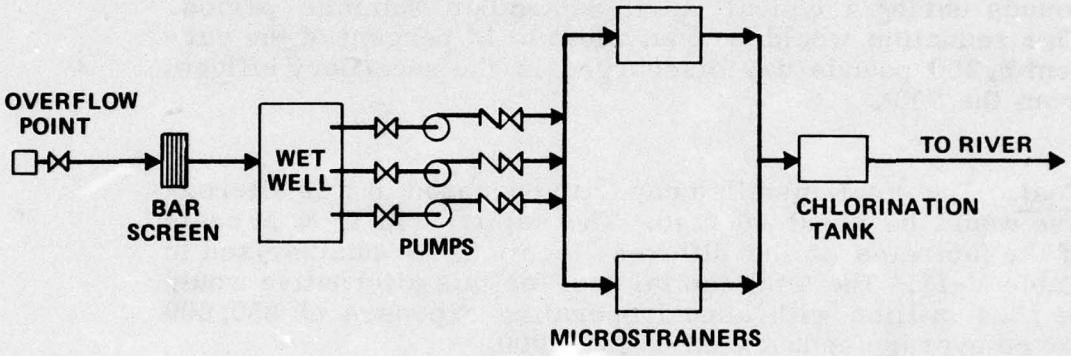


FIGURE V-12

a. Short Term (reduction per storm)

BOD Load Reducton = 4,700 lbs.

NOD Load Reduction = 700 lbs.

Coliform - reduce effluent total count to 15,000/100 ml and Susquehanna River count to 1,000/100 ml.

b. Long Term. This alternative would reduce the BOD pollution load discharge to the Susquehanna River by an average of 125,000 pounds during a typical April-September period. This reduction would be equivalent to 23 percent of the current 3,000 lb/day daily effluent BOD from the Binghamton-Johnson City STP. It would also reduce the NOD load to the Susquehanna River by an average of 125,000 pounds during a typical April-September summer period. This reduction would be equivalent to 13 percent of the current 5,200 pounds/day discharged in the secondary effluent from the STP.

Cost. The total installed capacity proposed in this alternative would be about 40 mgd. The capital and O & M costs of the facilities at the different locations is summarized in Table V-17. The total capital cost for this alternative would be $3.4 million with annual operating expenses of $50,000 for an average annual cost of $311,000.

TABLE V-17

ALTERNATIVE B
MICROSTRAINER CAPACITIES AND COSTS

Overflow Point (Fig. V-16)	Flow CFS	Flow MGD	Construction Cost ($)	O & M $/year
1	15	10	$800,000	$13,000
2	10	6.5	600,000	8,000
3	15	10	800,000	13,000
4	10	6.5	600,000	8,000
5	10	6.5	600,000	8,000
	60	39.5	$3,400,000	$50,000

Alternative C: Treatment at Overflow Sites Using Dissolved Air Flotation.

Main Characteristics. This alternative provides combined overflow treatment using dissolved air flotation. In this process, fine air bubbles are forced into the overflow holding tanks. As the bubbles attach to solid particles or liquid droplets, the bouyant force of the combined particle and air bubble causes it to rise. Particles floating to the surface are then removed by skimming. Five treatment facilities, ranging in capacity between 6.5 and 10 mgd would be located at the sites shown in Figure V-15. A flow diagram of the Dissolved Air Flotation System is shown in Figure V-13.

Effectiveness.

1. The minimum instantaneous DO level during the design storm (1.25 inch/day) would be between 4 mg/l and 5 mg/l in conjunction with secondary or improved secondary treatment of wastewater. In conjunction with AWT or land treatment systems, the minimum instantaneous DO level would be 5 to 6 mg/l.

2. A reduction of pollution loads due to combined sewer overflows would result.

a. Short Term (reductions per storm).

BOD Load Reduction = 5,600 lbs.

NOD Load Reduction = 700 lbs.

Coliform - reduce effluent total count to 15,000/100 ml, and Susquehanna River count to about 1,000/100 ml.

b. Long Term. This alternative would reduce the BOD pollution load discharged to the Susquehanna River by an average of 150,000 pounds during a typical summer period. This reduction would be equivalent to 28 percent of the current 3,000 lb/day effluent BOD from the Binghamton-Johnson City STP.

It would also reduce the NOD load discharged to the Susquehanna River by an average of 125,000 pounds during a typical summer period. This reduction would be equivalent to 13 percent of the current 5,200 lbs/day discharged in the secondary effluent of the STP.

ALTERNATIVE C: DISSOLVED AIR FLOTATION FLOW DIAGRAM

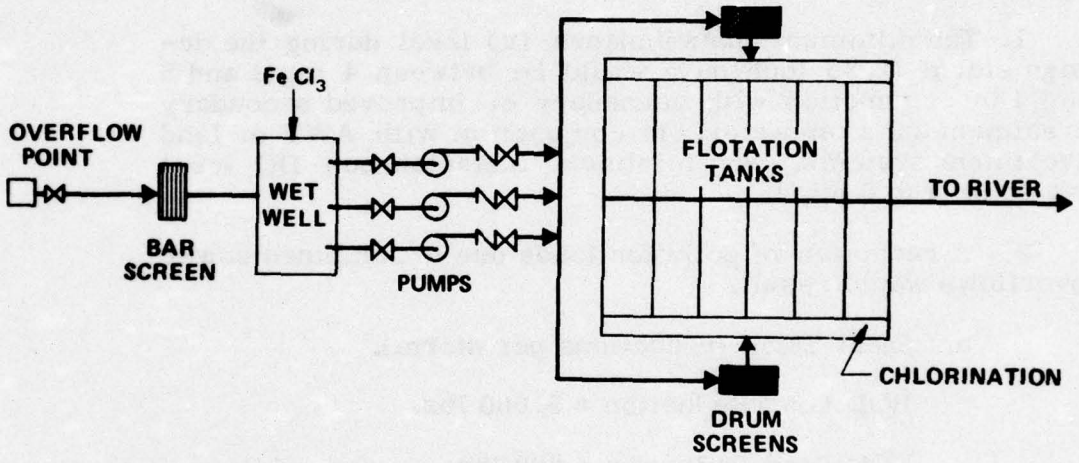


FIGURE V-13

Cost. The total installed capacity in this alternative would be about 40 mgd. The capital and O & M of the facilities required at the five locations is shown in Table V-18. The total capital cost for this alternative would be $4.0 million with an annual operating cost of $77,000 for an average annual cost of $386,000.

TABLE V-18

ALTERNATIVE C
DISSOLVED AIR FLOTATION CAPACITIES AND COSTS

Overflow Point (Fig. V-15)	Flow CFS	Flow MGD	Construction Cost	O & M $/year
1	15	10	$950,000	$19,300
2	10	6.5	700,000	13,000
3	15	10	950,000	19,000
4	10	6.5	700,000	13,000
5	10	6.5	700,000	13,000
TOTAL	60	39.5	$4,000,000	$77,000

Alternative D: Centralized Treatment of Combined Overflows Using Modified Biological Treatment.

Main Characteristics. A system of interceptors would collect the overflows to a central treatment facility to be built either on the existing Binghamton-Johnson City STP site or in one of the two sites shown in Figure V-14. The facility would be a modification of the contact stabilization activated sludge process (secondary treatment). Provided present the treatment plant site has enough vacant land, it would be advantageous to build the facility at the existing STP to achieve dual use of the facility during dry and wet weather conditions. Also, a saving in O & M costs could be achieved this way. If upgraded treatment facilities are to be built on the available vacant land, then site #2 would be the next desirable location for the combined sewer overflow treatment facility.

LOCATION OF CENTRAL TREATMENT SITES ALTERNATIVE D

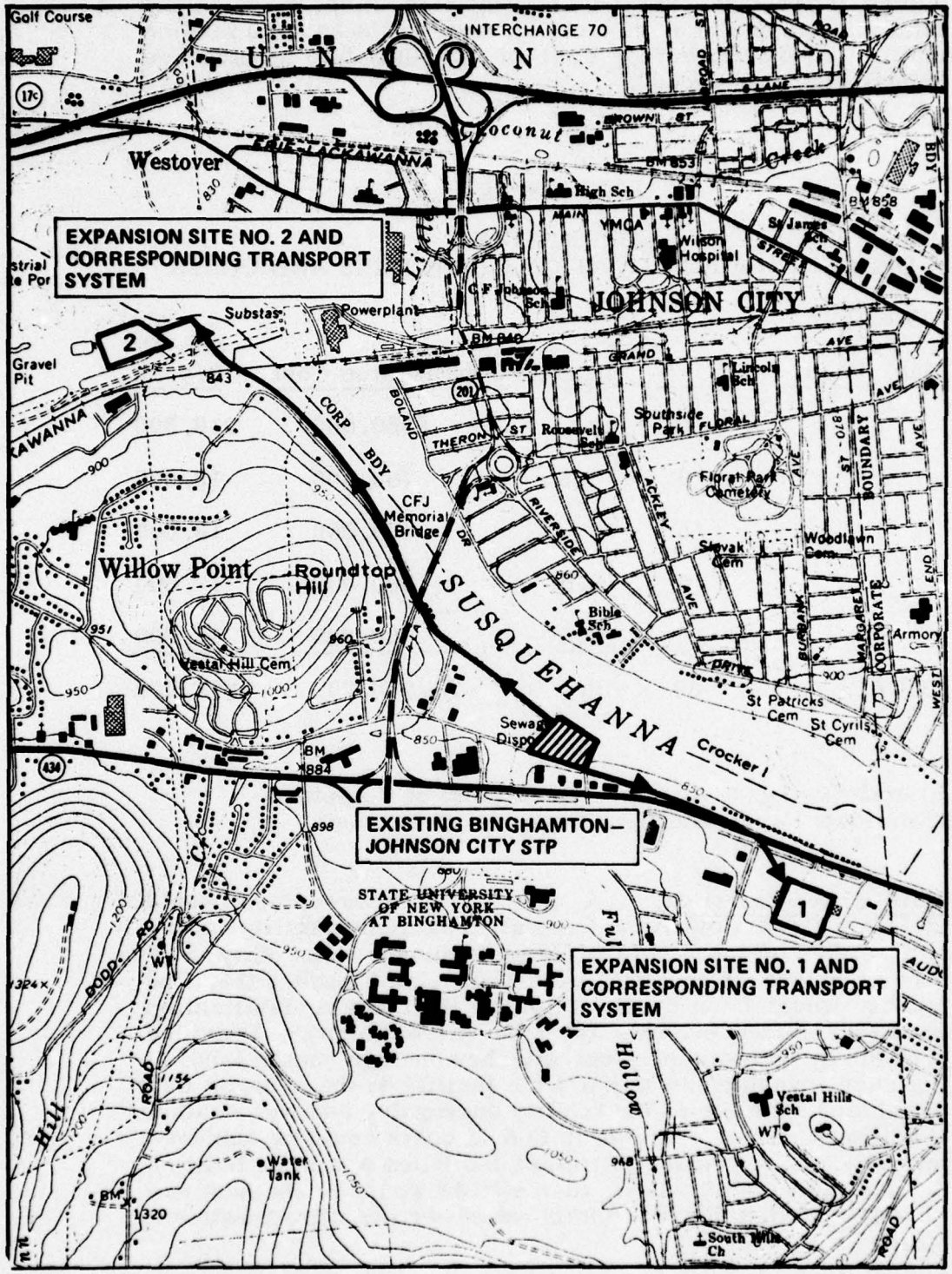


FIGURE V-14

The new interceptors included in this system would replace some of the existing trunk and interceptor lines that are old and subject to high infiltration rates. This may prove effective in controlling significant amounts of infiltration. These interceptors would also provide enough capacity to handle wastewater flows from the communities surrounding the City of Binghamton, thus enabling the existing Binghamton-Johnson City STP to serve these communities. The centralized storm overflow treatment facility could also be used during dry weather flow for treating the projected increase in wastewater flows.

Effectiveness.

1. The minimum instantaneous DO level during the design storm (1.25 inch/day) would be between 5 mg/l and 6 mg/l in conjunction with any of the dry weather wastewater treatment alternatives.

2. A reduction in pollution loads due to combined sewer overflows would be achieved.

a. Short Term (reductions per storm).

BOD Load Reduction = 7,800 lbs.

NOD Load Reduction = 2,100 lbs.

Coliform - reduce effluent total count to 1,000/100 ml.

b. Long Term: This alternative would reduce the BOD pollution load discharged to the Susquehanna River by an average of 207,000 pounds during a typical summer period. This reduction is equivalent to 38 percent of the current 3,000 lbs/day effluent BOD from the Binghamton-Johnson City STP.

It also would reduce the NOD load discharged to the Susquehanna River by an average of 75,000 pounds during a typical summer period. This reduction would be equivalent to 8 percent of the current 5,200 pounds/day discharged in the secondary effluent of the STP.

Cost. The total installed capacity of this alternative would be 50 mgd. The total capital cost for this system would be $23 million. The annual operating cost would be $63,000 for an average annual cost of $1,888,000.

Summary of Costs.

Summarized in Table V-19 are the capital costs, operation and maintenance (O & M), and total average annual cost for each of the four storm management alternatives. Although the original work was performed at a 5 7/8 percent interest rate, the costs were later revised to reflect the 6 1/8 percent interest rate used in the Stage III-2 analysis. For ease of understanding, only the costs for the 6 1/8 percent interest rate are presented in Table V-19.

Site Investigation for Locating Combined Overflow Facilities

Photographic maps of the City of Binghamton were examined to define potential sites for locating combined overflow control facilities. Because of extensive development within Binghamton, sites for such facilities were quite limited. Site visits and preliminary investigations were conducted to define locations with sufficient area for an overflow control structure.

Stormwater control for the combined sewer system in the City would be provided at the five sites depicted in Figure V-15. The two major considerations for the sites finally selected were their proximity to an overflow point (based on SWMM predictions) and the fact the adjacent land was presently vacant.

Probability of Exceeding the Capacity of the Storm Overflow Control Alternatives

The design storm is a 1.25 inch storm in a 24 hour period. During the 30 year period of analysis, the total number of rainfall events that exceeded the 1.25 inch level was 58. This means on the average during the April-October period, 1.9 storms will exceed the 1.25 inch level. Therefore, the storage capacity of the basins (Alternative A) would also be exceeded on the average two times every year.

To estimate the probability of exceeding the capacity of the treatment alternatives (B, C, and D) a frequency analysis of the intensity of rainfall (in/hr) in the Binghamton area would be necessary. However, a qualitative statement may

TABLE V-19

SUMMARY OF COSTS OF STORMWATER MANAGEMENT ALTERNATIVES FOR THE CITY OF BINGHAMTON

Cost	ALTERNATIVE A Storage	B Microstrainers	C Dissolved Air Flotation	D Centralized Treatment
Capital ($)[3]	22,200,000	3,400,000	4,000,000	23,000,000
O & M ($/year)[3]	240,000	50,000	77,000	63,000
Average Annual Cost ($/year)[1]	1,930,000	311,000	386,000	1,888,000
Annual Capital Cost per 1,000 Gallons Treated ($/1,000 gal.)	4.20	0.70	0.87	4.26
Average Cost per 1,000 lbs BOD Removal ($/1,000 lbs)	8.50	2.49	2.57	9.11
Total Annual Costs/ Capita ($/capita)[2]	30	4.87	6.00	29

[1] 6 1/8% interest rate, 50 year economic life, with major replacements after 27 years.

[2] Based on current City population of 64,000.

[3] January 1975 prices

CITY OF BINGHAMTON
LOCATION OF PLANNED OVERFLOW CONTROL FACILITIES

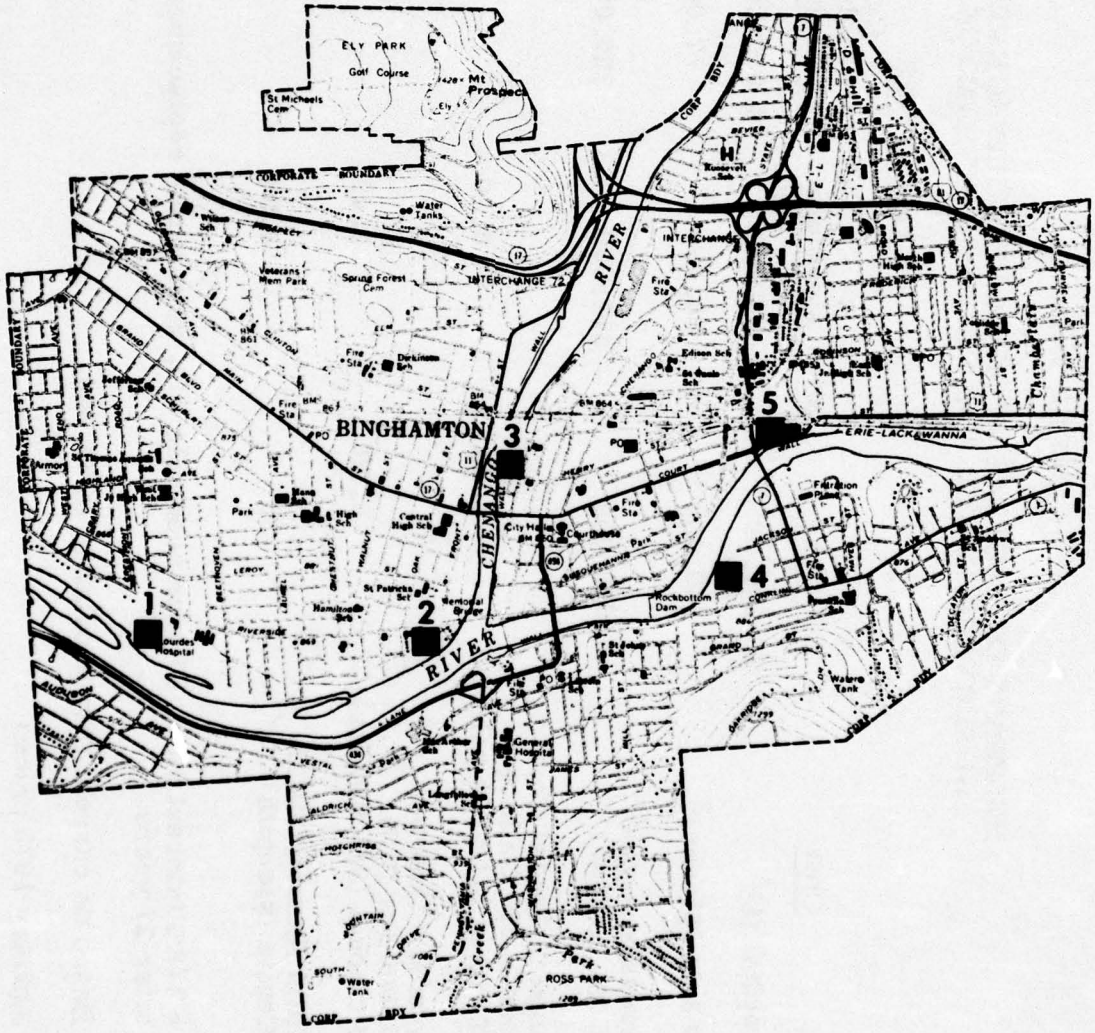


FIGURE V-15

be made as a preliminary estimate. The maximum intensities of the design storm were calculated for different durations along with those of the ten year return periods as shown in Figure V-16. Considering the relationship between the design storm intensity-duration and the one year return period storm, the intensity (inches/hour) of the design storm is less than one half of the intensity of the one year storm. The 24 hour volume of the design storm is slightly more than half of the one year storm. Hence, the rate capacity of Alternatives B, C, and D, may be exceeded more than 1.9 times per season. It should be noted that exceeding the capacity of any alternative would result in the discharge of untreated combined sewer overflows to the Susquehanna River. This may result in lower DO levels than those reported in evaluating the alternatives, provided the larger storm occurred during the MA-7-CD-10 flow. However, most pollutants are contained in the "initial flush" of the sewer system at the beginning of a storm, and the dilution factor later in the storm may lessen the effect of combined overflows on the river's DO.

Environmental Impact Summary

None of the municipal wastewater management alternatives contain provisions for the management and treatment of combined sewer overflows. These overflows represent a significant portion of the BOD, NOD, coliform bacteria, and heavy metals entering the river in the urban area. Table V-20 summarizes the annual contributions of BOD and NOD from the overflows of combined sewers at selected rainfall amounts with no control of stormwater.

INTENSITY-DURATION-FREQUENCY CURVES

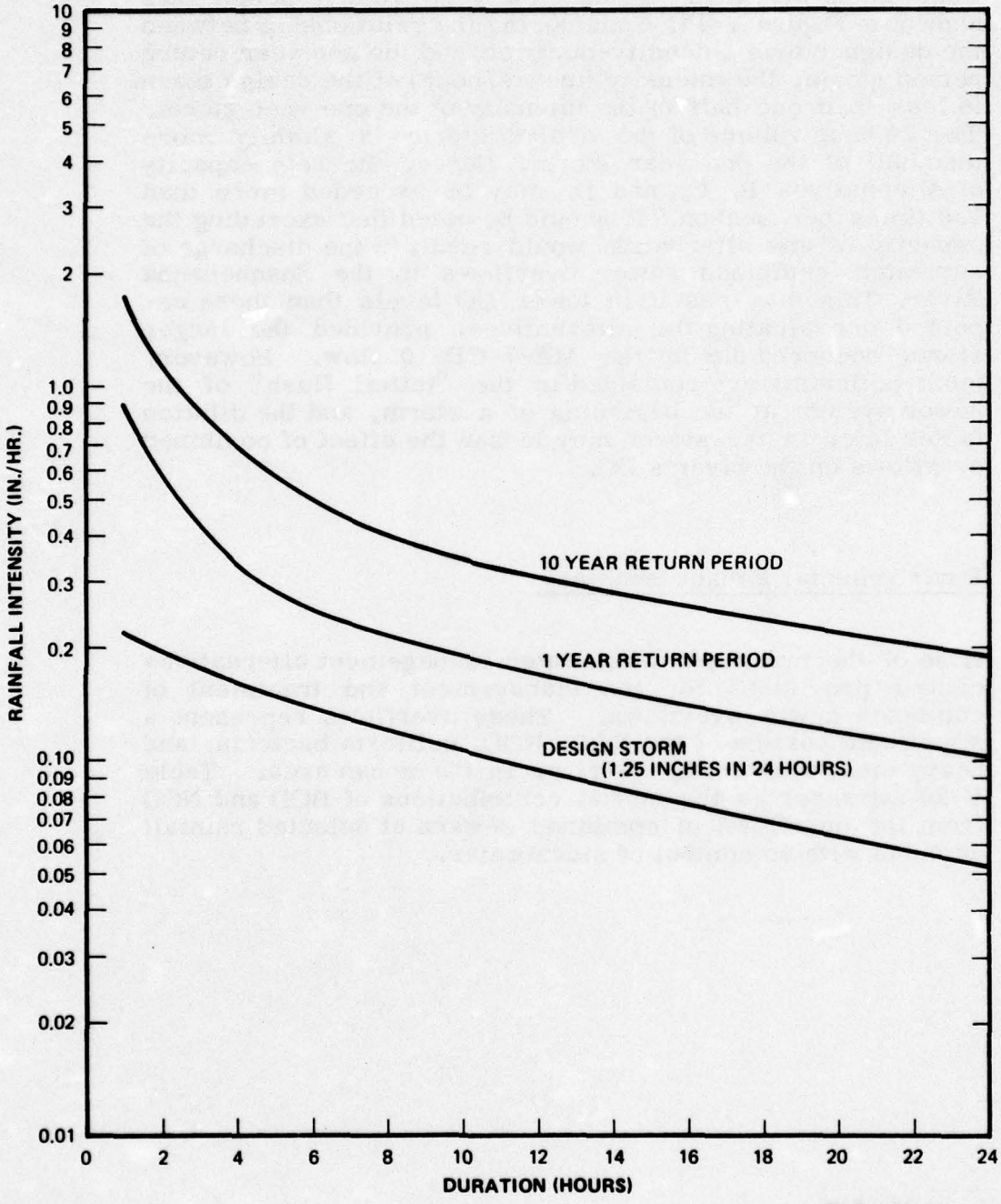


FIGURE V- 16

TABLE V-20

STORMWATER OVERFLOW ANNUAL POLLUTANT LOADS
WITHOUT OVERFLOW CONTROL

Rainfall (inches)	Number of Days of Occurrence per Year	Annual Overflow Volume (10^6 Gallons)	Annual BOD[1] (10^6 lb)	Annual NOD[2] (10^6 lb)
0.3	33	99	145	89
0.7	9	72	74	43
1.4	3	51	30	15
TOTAL		222	249	147

[1]Biochemical Oxygen Demand

[2]Nitrogenous Oxygen Demand

Aquatic Ecology.

Table V-21 indicates the effectiveness of each stormwater overflow management scheme as compared to a no action alternative in which stormwater overflows are not handled. Also shown are the minimum dissolved oxygen concentration and the maximum total coliform count in the River which would be experienced during the design storm (1.25 inches of rain over a period of 24 hours) for each stormwater management scheme as compared to a no action alternative.

TABLE V-21

EFFECTIVENESS OF STORMWATER MANAGEMENT ALTERNATIVES[1]

Effect	No Action	A Storage	B Micro-strainers	C Dissolved Air Flotation	D Centralized Treatment
			ALTERNATIVES		
Overflow Load					
BOD (lb)	9,400	940	4,700	3,800	1,600
% Reduced	0	90	50	60	83
NOD (lb)	4,200	2,100	3,500	3,500	2,100
% Reduced	0	50	17	17	50
Minimum Instantaneous DO (mg/l)	3-4	5-6	4-5	4-5	5-6
Coliform in Susquehanna River (MPN/ 100 ml)	240,000	1,000	1,000	1,000	1,000

[1] Based on 1.25 inch storm in 24 hours.

With a no action alternative, oxygen demanding wastes entering the river would reduce the in-stream DO concentration to 3-4 mg/l during the design storm. Such reductions to in-stream DO concentrations would violate the NYSDEC criteria of not less than 4.0 mg/l DO at any time. Microstraining (Alternative B) or dissolved air flotation (C) treatment schemes would result in minimum instantaneous DO concentration of 4-5 mg/l and therefore would represent a beneficial impact to the aquatic ecology. Storage and treatment (A) of the stormwater overflows or modified biological treatment (D) of overflows would result in the most beneficial impacts to aquatic ecology by the maintenance of a minimum instantaneous DO concentration of 5-6 mg/l. The exact concentration of heavy metals within the overflows of combined sewers is unknown. However, it has been demonstrated in other areas of the country that high concentrations of heavy metals exist in separate storm sewers alone. Therefore, it is logical to assume the combined sewer overflow would also have high heavy metal concentrations. Under a no action alternative, no removals of heavy metals would

be realized, thus adversely affecting in-stream biota. Microstraining and dissolved air flotation treatment of storm overflows would probably not result in significant removals of heavy metals and would therefore not result in any significant beneficial impacts. Modified biological treatment of storm overflows would somewhat reduce the concentration of heavy metals entering the river and would therefore result in a beneficial impact to the aquatic biota. Storage and subsequent treatment would result in the greatest reductions of heavy metals and would therefore have the most beneficial impacts upon aquatic biota. The most positive way of eliminating heavy metals in the sewer system, however, is through active enforcement of city and village ordinances prohibiting such discharges to the public systems.

All the action alternatives would provide chlorination for disinfection of overflows. However, chlorine is toxic to aquatic life and dosages should be minimized to reduce adverse impacts. One possible mitigating measure would be to substitute ozonation as a disinfectant in place of chlorine.

Terrestrial Ecology.

Some adverse ecological impacts of the overflow management schemes would occur during the construction of necessary facilities. It is not expected, however, that any scheme would create major adverse terrestrial impacts of a long-term nature.

Public Health Impacts.

Discharge of raw sewage during periods of combined sewer overflows are illegal and represent a public health hazard. Coliform counts have been observed as high as 240,000 MPN/100 ml in the Susquehanna River and 120,000 in the Chenango River, of which the major contributing factor is overflows. Chlorination would be provided for all action alternatives. Therefore, each stormwater management scheme would be equally beneficial to public health as stream standards for bacteria would no longer be violated (less than 2,400 MPN/100 ml for Class B, water contact recreation, Standards).

Aesthetic-Recreational Impacts.

Since in-stream fecal and total coliform counts are greatly increased by overflows of combined sewers, each stormwater

management scheme would represent a beneficial impact upon water quality. High coliform levels currently found in the Susquehanna River in the urban area prohibit primary contact recreation. With chlorination of stormwater effluents in combination with a treatment-management scheme, significant reductions in coliform bacteria could be obtained. The storm overflow management schemes under consideration could achieve Susquehanna River total coliform concentrations of about 1,000 MPN/100 ml, meeting the Standard for water contact recreation (less than 2,400 MPN/ 100 ml).

Socio-Economic Impacts.

Stormwater management schemes would have little impact upon development. Imaginative engineering, architectural design, and landscaping would minimize any adverse impacts to adjacent land uses caused by the construction of facilities within the urban and suburban environments.

Political-Institutional Impacts.

Financial impacts would depend largely on the institutional arrangements. Institutional arrangements for stormwater management schemes might create adverse political ramifications especially if stormwater management schemes are combined with other wastewater management schemes. Determination of the financial responsibilities of stormwater management would be difficult under any wastewater regionalization scheme.

Selection of Stormwater Management System

Selection of Alternatives.

The four stormwater management alternatives developed for the City of Binghamton were:

1. Storage with release to Binghamton-Johnson City Sewage Treatment Plant.

2. Microstrainers at overflow sites.

3. Dissolved air flotation at overflow sites.

4. Modified secondary biological treatment at a centralized site.

The three study management groups, Citizens Advisory Committee (CAC), Technical Advisory Committee (TAC), and the Interagency Study Management Group (ISMG) reviewed the four proposals.

Table V-22 summarizes the annual cost, pollutant reduction, and resulting river minimum instantaneous DO levels for each of the schemes. Alternatives A and D were comparable based on cost, pollutant reduction, and resulting minimum instantaneous DO in the river (between 5-6 mg/l). Alternatives B and C were also comparable basedon the same factors (DO between 4 and 5 mg/l).

In the absence of specific regulations requiring secondary treatment for storm overflows, the ISMG participants expressed an interest in those alternatives providing a cost-effective approach while maintaining the river DO level above the minimum standard of 4 mg/l. Therefore, the high costs of alternatives A and D, which achieve 5-6 mg/l minimum instantaneous DO, were not attractive. Additionally, both of these schemes would involve major construction activities.

TABLE V-22

ANNUAL COST AND EFFECTIVENESS
STORMWATER MANAGEMENT ALTERNATIVES
CITY OF BINGHAMTON

	ALTERNATIVES			
	A Storage	B Micro-strainers	C Dissolved Air Flotation	D Centralized Treatment
Average Annual Cost ($/yr)*	1,930,000	311,000	386,000	1,888,000
Percent Reduction				
BOD	90	50	60	83
NOD	50	17	17	50
Susquehanna River Minimum Instantaneous DO (mg/l)	5-6	4-5	4-5	5-6

*6 1/8 percent interest rate for 50 years.

The management groups reached a general consensus that on-site treatment with either Alternative B, microstrainers, or C, dissolved air flotation, would be desirable. In considering the merits of each, Alternative C would remove a slightly higher percentage of BOD but Alternative B would be easier to operate, would have fewer mechanical problems, and had the least cost.

Recommendations.

Based on recommendations of the other two committees, the ISMG selected Alternative B, utilizing microstrainers and chlorination for treatment of combined sewer overflows. Although the secondary treatment level would not be attainable with the microstrainer process, it was acceptable to the agencies comprising the ISMG as this process could remove a majority of settleable material at a minimum of cost and would meet stream standards. Under this alternative, excess combined sewer flow in the City system resulting from the design storm of 1.25 inches in 24 hours would be treated at five overflow sites (see Figure V-16) prior to discharge to the Susquehanna and Chenango Rivers. Alternative

B was recommended as a component to each wastewater management plan developed in Stage III.

SLUDGE MANAGEMENT

The alternatives for wastewater treatment developed in Stage II implicitly included the costs of sludge handling. Costs were obtained from curves which included sludge management or, in the case of secondary treatment, were based on actual operating experience in the Bicounty Study Area. However, no analysis was performed on the various alternatives for sludge processing and disposal. The purpose of this section is to document the selection of a specific sludge management scheme for each wastewater treatment level carried forward into Stage III.

SLUDGE - WHAT IT IS

Sludge is the material remaining after wastewater is treated. It consists of a thick suspension of solids, mostly organic, and is usually drawn from the bottom of clarifiers or settling basins. Only a small portion (less than 5 percent) of untreated sludge is solid matter.

An analysis of sludge management alternatives is important as 25 to 50 percent of the cost of conventional (primary and secondary) treatment can be charged to sludge processing and disposal. The fraction of treatment plant cost attributable to sludge disposal generally increases with increasing plant size. The method used to handle sludge from advanced waste treatment systems is critical to the successful and economic operation of the plant.

Sludge requires treatment to (1) reduce the volume of the material to facilitate subsequent handling and disposal; (2) decompose organic matter to stabilize the material and render it inoffensive; and (3) destroy pathogens.

Various combinations of treatment techniques are used and depend on such factors as the characteristics of the sludge and the amount of land available for final disposal.

In sewage treatment plants, solids are collected from screens and grit chambers in addition to the sludge from treatment processes. The grit and screening wastes are commonly disposed in a landfill, and as they retain little water, the amount to be handled is small in comparison to the volume of sludge.

Usually sludge from primary and secondary treatment processes is first fed to a thickner to reduce the volume of water and then transferred to anaerobic digesters where it is stabilized to remove odors and to facilitate dewatering. Methane gas produced in the digestion process can be recycled for heating purposes. Digested sludge may be conditioned either with heat or by chemicals. Lime, ferric chloride and polymers can be used for conditioning the sludge. The sludge is then dewatered either with the help of vacuum filtration or centrifugation. In the case of many small plants, sludge is dewatered on drying beds without prior addition of chemicals for sludge conditioning. Digested, dewatered sludge (about 75 percent to 80 percent of which is water) is disposed in a dump or a landfill site; applied to the land as a soil conditioner; and/or heat dried and fortified with nutrients for use as a fertilizer. Disposal of waste sludge into lagoons is also a common method.

Disposal of liquid (not dewatered) digested sludge by tank truck by spraying on agricultural land is inexpensive, practical, and is used by many small to medium size municipalities. Many large cities utilize incineration for further reduction in the volume of digested, dewatered sludge before final disposal of the ash to a landfill. Marketing of dried waste sludge as a fertilizer has generally been unsuccessful due to the high cost of heat drying and the large volumes of material involved.

Land disposal is presently the most frequently used method for the final disposal of sewage sludge. At a national scale, about 70 percent of the sludge produced in wastewater treatment is being disposed on land; about half of this amount is utilized for agricultural purposes, with the remainder disposed to landfills.

EXISTING SLUDGE MANAGEMENT PRACTICES IN BROOME AND TIOGA COUNTIES

Table V-23 summarizes approximate quantities and types of sludge generated and existing sludge handling practices for each of the sewage treatment plants. At present, the digested sludge generated from the seven sewage treatment plants in the urban area amounts to approximately 9.2 tons per day, based on dry solids. Assuming 20 percent solids concentration in the dewatered sludge, the amount of sludge to be hauled for disposal is approximately 46.5 tons per day or 1,400 cubic feet per day.

Binghamton-Johnson City Joint Sewage Treatment Plant

Sludge from the primary and secondary treatment units is concentrated by thickeners, stabilized in anaerobic digesters, and then dewatered with vacuum filters and chemicals. For years this dewatered sludge had been disposed at no cost at a landfill site, a private horticultural operation (Bob Murphy, Inc., Vestal, New York), where the sludge was used as a soil conditioner. However, in 1974, Mr. Murphy informed the Binghamton-Johnson City Joint Sewage Board that the horticultural operation was ceasing and that the arrangement was no longer desirable. He has officially requested to the Joint Sewage Board reimbursement at the rate of $300.00 per month if continued handling were required. A temporary arrangement has been worked out for continuing disposal of sludge at this landfill site while other options for sludge disposal are being investigated.

Total processing and disposal costs are about $60 per ton of dry solids. With an average removal of 5.5 tons per day, the yearly cost attributable to sludge would be approximately $120,000.

At the sewage treatment plant, the following steps have been undertaken to reduce costs and to prepare alternative means of final disposal.

1. Experimentation with polymers for sludge conditioning to facilitate dewatering thereby reducing the quantity of sludge to be hauled for disposal.

TABLE V-23

EXISTING SLUDGE MANAGEMENT PRACTICES IN BROOME AND TIOGA COUNTIES

Name	Service Area	Sewered Population	Design Capacity mgd	Type of Treatment	Digested Sludge Produced Dry Solids T/Day	Method of Sludge Handling
Binghamton-Johnson City Joint STP	Binghamton City Johnson City (V) Binghamton (T) S.D. 1,2,3,4,6&8 Kirkwood (T) S.D. 1 Vestal (T) S.D. 4,7,11 & 12 Dickinson (T) S.D. 2,3 & Stella District Port Dickinson (T) Union (T) Westover S.D. SUNY	102,000	18.25	A/S or C/S and Chlorination	5.5	AD, MDW, VF, LF, or to public as soil conditioner
Vestal STP	Sewer Districts 1, 5, 6	7,500	1.0	PT and Chlorination	0.28+	AD, DB & to public as soil conditioner
Endicott STP	Endicott (V) Endwell Park Manors North Endicott West Endicott West Corners Airport Heights	44,700	7.67	HR T/F and Chlorination	2.64	AD, MDW, VF, and LF

TABLE V-23 (Continued)

Name	Service Area	Sewered Population	Design Capacity mgd	Type of Treatment	Digested Sludge Produced Dry Solids T/Day	Method of Sludge Handling
Owego (T) STP #1	Western Section of Town of Owego S.D. 1	600	0.5	T/F and Chlorination	0.19	AD, Liquid sludge for land application
Owego (T) STP #2	Eastern Section of Owego (T) S.D. 2, 3, 6 & 8	6,500	2.0	A/S or C/S & Chlorination	0.42+	AD, Liquid sludge for land application
Owego Village STP	Other than Valley View Service Area	3,600	0.62	PT and Chlorination	0.14+	AD, DB, & disposed to LF
Owego (V) Valley View STP	Small community in southern section of the Village	500	-	IT and Chlorination	0.02+	AD, DB, and to public as soil conditioner

List of Abbreviations:

AD - Anaerobic Digester
A/S - Activated Sludge Process
C/S - Contact Stabilization
DB - Drying Beds
IT - Imhoff Tank
LF - Land Fill
MDW - Mechanical Dewatering
PT - Primary Treatment
S.D. - Sewer District
STP - Sewage Treatment Plant
T/F - Trickling Filter (HR-High Rate)
VF - Vacuum Filter
(T) - Town
(V) - Village
+ Estimates

2. Cleaning the old drying beds to remove about 80 per cent of the water remaining after filtering. This would decrease the quantity of sludge to be hauled for disposal, but would increase handling time and costs of the sludge.

3. Request to Southern Tier East Regional Planning Board for investigation of possible land application program for year-round disposal of liquid sludge on agricultural land. An application of liquid sludge would eliminate the costly method of vacuum filtering.

Endicott Sewage Treatment Plant

The sludge from the primary settling tanks and trickling filters is withdrawn continuously and distributed to two sludge thickeners, followed by anaerobic digestion and vacuum filtration with chemicals. Dewatered sludge is hauled away in trucks to a landfill site about 1/4 mile from the Endicott sewage treatment plant.

Total costs for sludge processing and disposal are about $39 per ton of dry solids. With approximately 2.6 tons removal per day, the average yearly cost would be $40,000.

The Endicott landfill site, approximately 55 acres, is located on the north bank of the Susquehanna River. This landfill site is used for disposal of solid waste from the Village of Endicott and the Town of Union as well as for the disposal of sludge from the Endicott sewage treatment plant. No information is available on the possible leaching of materials from the solid waste or sludge into the river.

Vestal Sewage Treatment Plant

The Vestal Sewage Treatment Plant is a primary treatment system with sludge pumped to a anaerobic digester once per day. The sludge is then dewatered in drying beds. The dried sludge, about 0.3 tons of dry solids per day, is removed by farmers or other town individuals for use as a soil conditioner. There is a great demand for this digested sludge, so a problem of disposal has not occurred.

Owego Sewage Treatment Plant No. 2

Sludge from the primary and secondary treatment units is pumped to a thickener and then anaerobically digested. Sludge is then withdrawn from the digester, as necessary, and is removed by a tank truck for spraying on farm land. The plant operator makes arrangements with farmers for sludge removal. Usually there is a good demand for this digested sludge (about 0.4 tons/day dry solids). If not, drying beds are available for use when needed.

Owego Sewage Treatment Plant No. 1

Primary and secondary sludge is fed twice per day to one anaerobic digester. Liquid digested sludge (about 0.2 tons/day dry solids) is hauled by tank trucks for land application. There is only one tank truck in use for both Owego Plants 1 and 2.

Owego Village - Village Sewage Treatment Plant

This plant is currently a primary treatment system. Primary sludge is stabilized in anaerobic digesters. Liquid digested sludge (about 0.14 tons/day dry solids) is pumped to drying beds than hauled to a landfill near Candor. The gas produced in the digesters is not utilized for heating the digesters because of a malfunction of the heating systems. The digester gas is burned. The heating system will be redesigned during upgrading of the treatment plant to a secondary system.

Owego Village - Valley View Sewage Treatment Plant

This is an Imhoff tank serving only the small communities in the Village of Owego on the southern bank of the Susquehanna River. The Imhoff tank consists of a two story tank in which sedimentation is accomplished in an upper compartment, and digestion in a lower compartment. Settling solids pass through slots into the lower compartment and in adjoining vents. Gas produced in the digestion process

escapes through the vents and is an odor nuisance for the nearby area. The Valley View treatment plant will be phased out after the construction of a south side interceptor to transport the waste to the Village treatment plant. The construction of the south side interceptor is scheduled for 1976.

PRELIMINARY SCHEMES FOR SLUDGE MANAGEMENT

Description of Systems

Several sludge handling schemes were formulated for the purpose of cost comparison. These systems are shown schematically in Figure V-17. The cost comparisons developed were for a generalized situation and are presented for ranges of plant sizes.

Scheme I.

In this strategy, primary and secondary sludges would be transferred first to a thickener and then to a digester. Digested sludge would be pumped to sludge drying beds and spread with the help of perforated pipe. Dried sludge (solid concentration 25-45 percent) is trucked away for land application. This system is mainly used for small to medium size capacity (2 to 5 mgd) plants.

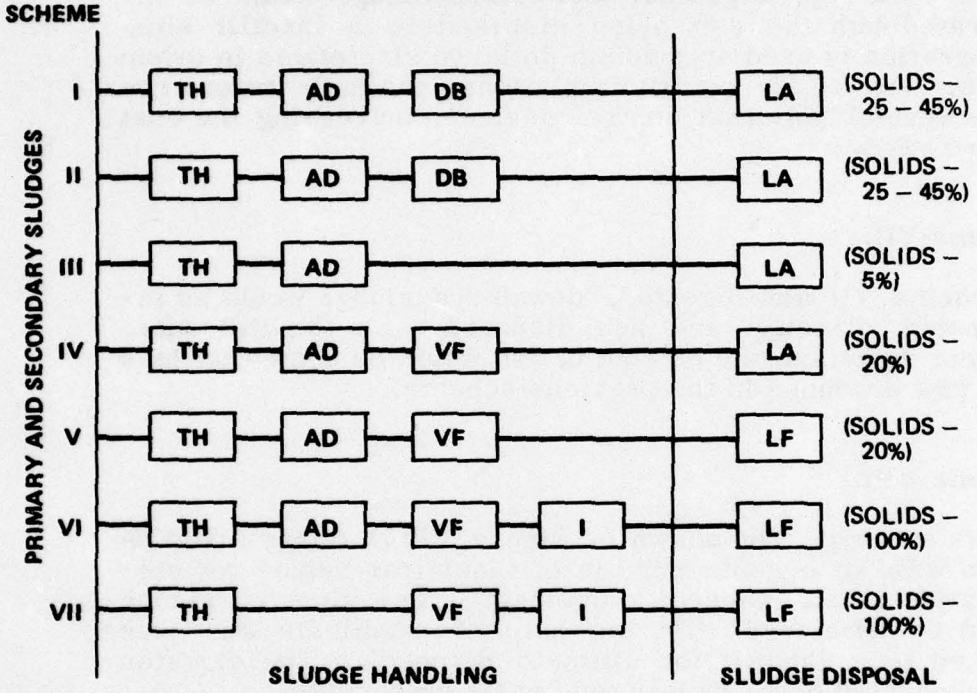
Scheme II.

Scheme II had the same process as Scheme I, except dried sludge would be disposed of at a sanitary landfill site.

Scheme III.

In this strategy, thickened sludge would be stabilized in an anaerobic digester, and then, without dewatering, sent for direct application on agricultural lands. This system would be applicable to a treatment plant of any size.

PRELIMINARY SCHEMES FOR SLUDGE HANDLING AND DISPOSAL



TH – THICKENER
AD – ANAEROBIC DIGESTER
DB – DRYING BEDS
VF – VACUUM FILTER
I – INCINERATOR
LA – LAND APPLICATION
LF – LAND FILLING

FIGURE V- 17

Schemes IV and V.

Schemes IV and V are parallel to Schemes I and II, respectively. The latter systems would employ drying beds for dewatering whereas the former would use vacuum filtration.

Scheme VI.

In this strategy, digested, dewatered sludge would be incinerated with the ash being disposed to a landfill site. Incineration is used in medium to large size plants in urban areas. Due to air quality regulations, the incinerators require special pollution control devices, increasing the cost of operation.

Scheme VII.

In Scheme VII non-digested, dewatered sludge would be incinerated directly; and ash disposed on a landfill site. Without digestion, the amount of ash would be somewhat less than that produced in the previous scheme.

Scheme VIII.

In this strategy (not shown in Figure V-17) sludge would be added with an organic portion of municipal refuse for stabilization in an anaerobic digester. The digested sludge would be dewatered with the help of chemicals and then trucked to a landfill for ultimate disposal. The digester gas generated could be utilized for its heat value.

Cost Comparison

Costs developed for the Schemes I-VII were made on the generalized bases of treatment plant size and sludge production. The comparisons were therefore independent of specific treatment plants or specific wastewater management alternatives. No comparable cost information was available for Scheme VIII, incorporating municipal refuse with sludge, due to the dependence of this cost on specific site analysis.

Costs for Strategies I-VII, based on characteristics of average treatment processes are presented in Table V-24. Costs for land were not included. Systems employing land application were assumed to use existing agricultural land rather than purchasing it.

In Schemes I and II, the cost of land required for sludge drying beds was not included, so actual costs would be slightly higher than presented. With an increase in plant capacity, the size of the sludge drying beds would likewise increase. The unit price of land would also increase, due to a change in the site location of the plant from a rural to an urban area. So the cost advantage of sludge drying beds for small plants diminishes with increasing plant size. Comparison of the costs for Schemes I and IV indicates that for small size plants, drying beds are less costly than vacuum filters. However, as the size of the plant increases to about mgd, the costs for the two systems become comparable. In larger treatment plants, sludge drying beds become impractical due to the volume of sludge and the amount of land needed for drying.

For small size plants, the cost difference between land application (Schemes I and IV) and landfilling (Schemes II and V) of digested, dewatered sludge would not be significant.

Comparing Schemes I with II and Scheme IV with V, the cost of land application and landfill are comparable. However, when the cost of land is included, landfill becomes the more expensive than land application.

The costs for incinerating either the digested, dewatered sludge (Scheme VI) or non-digested, dewatered sludge (Scheme VII) are comparatively higher than costs for other systems. This is due to the high capital investment for the incinerator. With an increase in plant size, the relative costs for incineration decrease considerably.

The direct land application of liquid digested sludge (Scheme III) is very cost-effective in comparison with all other systems. The cost-effectiveness of Scheme VIII, digestion of municipal refuse and sludge, could be realized in the value of the energy generated and the decrease in sludge and refuse disposal costs.

An important aspect for comparing these general schemes is that the costs for the same system vary considerably depending on the specific site and circumstances. For example, a survey conducted by the Environmental Protection Agency of the costs for land application of liquid digested

TABLE V-24

COSTS FOR TYPICAL SLUDGE MANAGEMENT SCHEMES[1]

CAPITAL COSTS ($1,000)

Sludge (Tons Dry Solids/Day)	Equivalent Wastewater Flow (mgd)	SCHEME I	II	III	IV	V	VI	VII
0.5	0.8	120	120	87	277	277	450	377
1.0	1.5	197	197	138	423	423	682	572
5.0	7.7	1,138	1,138	523	941	941	1,602	1,214
10.0	15.0			1,014	1,860	1,860	2,850	2,247
20.0	31.0			1,886	2,913	2,913	4,396	2,997

OPERATING COSTS ($1,000/year)

0.5	0.8	18	18	9	26	26	37	32
1.0	1.5	30	31	15	40	41	57	47
5.0	7.7	118	122	61	125	129	183	148
10.0	15.0			116	223	232	326	263
20.0	31.0			223	403	421	591	471

[1] See Figure V-17 for Strategy description.
Based on generalized performance criteria and treatment process costs and not on study area characteristics. Cost of land not included. For all schemes, round trip distance to disposal site to be 30 miles.

sludge in northwestern counties of Ohio found considerable cost variations: hauling by contract would cost on the average $31.92 per ton of dry solids and hauling by city-owned trucks would cost $7.73 per ton of dry solids (Manson and Merritt, 1973).

FORMULATION OF SLUDGE MANAGEMENT ALTERNATIVES

Development of Specific Alternatives

The eight schemes previously outlineo for the purpose of generalized cost comparisons were examined to select the most promising for detailed analysis.

Schemes I and II utilized sludge drying beds, rather than vacuum filtration, for dewatering in small treatment plants. These sand beds are used infrequently at both Town of Owego STPs No. 1 and 2 but are used exclusively at the Owego Village STP. However, since both the Binghamton-Johnson City and the Endicott STP's presently have vacuum filters and future plans call for one to be installed at Owego Village, sand beds were eliminated from the analysis.

Both Schemes III and IV employ land application of sludge as a soil conditioner. However, with the latter, sludge would be dewatered prior to application. Because of the difficulty and high cost of dewatering processes, Scheme IV was not further considered.

Schemes VI and VII both used incineration for final disposal. The increased cost of including a digester for Scheme VI without compensating benefits, eliminated this system from further study.

Scheme VIII, digestion of sludge with solid waste, was also eliminated because of the lack of available data on cost and dependability, and because of the comparative simplicity with which the other alternatives can be implemented.

The sludge management alternatives selected for specific analysis were basically similar to Schemes III, V, and VII. These alternatives, depicted in Figure V-18, include:

Alternative A - Incineration

Alternative B - Application of Liquid Sludge to Agricultural Land

Alternative C - Landfill of Dewatered Sludge

The analysis of the three alternatives considered the actual existing conditions, i.e., sludge quantities generated at each plant, the processing capabilities of each plant and current methods of sludge disposal. Existing disposal sites were also used in the analysis.

Projected Sludge Quantities

In general, sludge quantities for the year 2020 were determined on a pound per capita per day basis. This figure was obtained from either existing conditions, if known, or on typical design values and assumed to remain fairly constant throughout the planning period.

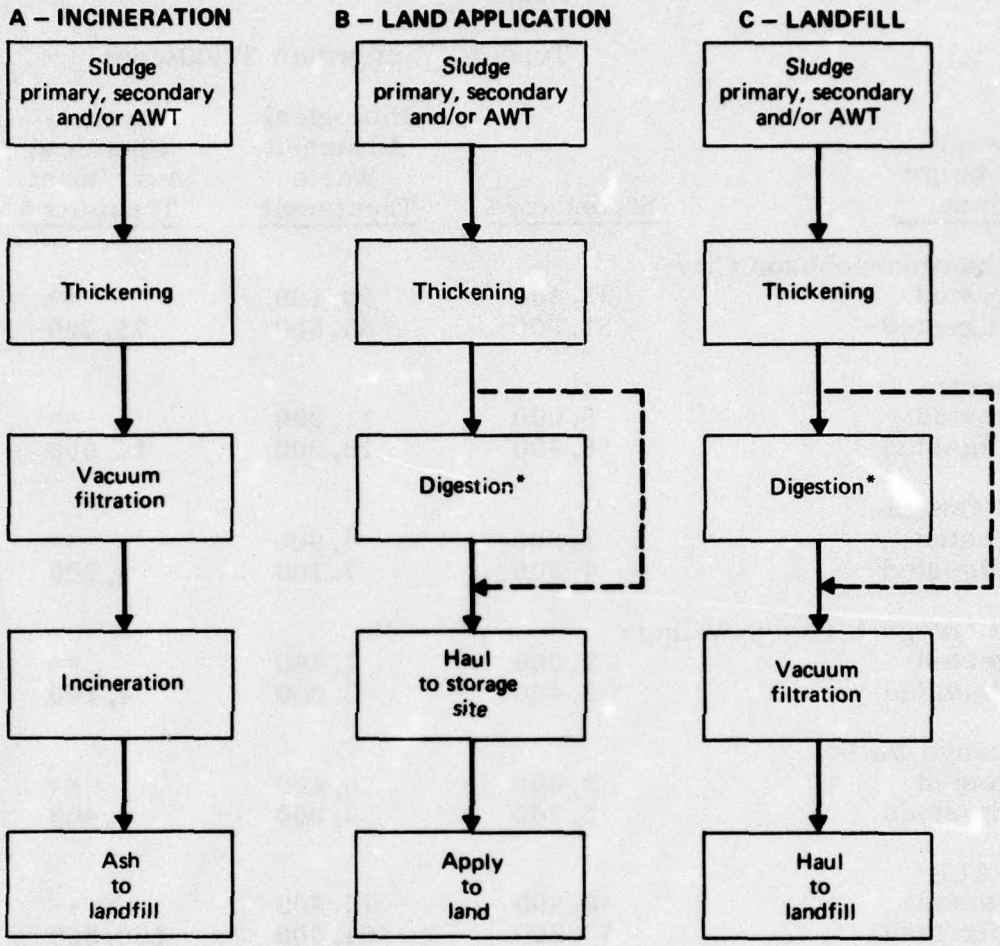
The amount of sludge produced is also a function of the level of wastewater treatment and therefore, the analysis was subdivided accordingly. For example, both the biological and physical/chemical advanced waste treatment systems would generate significantly more sludge than either secondary or secondary plus nitrification systems. Projected sludge quantities for the year 2020 are presented in Table V-25.

Description of Alternatives

Alternative A: Incineration.

Alternative A, incineration, involved: (1) thickening of the sludge by a gravity thickener; (2) dewatering by vacuum filtration; (3) incineration in a multiple hearth incinerator; and (4) hauling the ash by truck to a landfill for disposal.

SLUDGE MANAGEMENT ALTERNATIVES



*Not used for denitrified or physical-chemical sludges

FIGURE V- 18

TABLE V-25

SLUDGE QUANTITIES FOR YEAR 2020
(lbs/day)

Sewage Treatment Plant	Type of Wastewater Treatment: Secondary*	Biological Advanced Waste Treatment	Physical/ Chemical Adv. Waste Treatment
Binghamton-Johnson City			
digested	35,400	50,100	**
undigested	51,300	68,600	75,600
Endicott			
digested	5,000	11,800	**
undigested	8,400	16,000	14,900
East Owego			
digested	2,800	4,900	**
undigested	4,800	7,100	5,800
West Owego & Owego Village			
digested	2,000	3,400	**
undigested	3,400	5,000	4,100
Chenango Valley			
digested	3,200	5,400	**
undigested	5,300	7,900	6,400
TOTALS			
digested	48,400	75,600	--
undigested	73,200	104,600	106,800

*Same for secondary plus nitrification.
**Digestion process is not used for physical/chemical sludges.

Because the incineration process and related costs depend to a high degree on the percent moisture content of the sludge, it was necessary to include both thickening and dewatering processes. The combination of these two processes could reduce the moisture content of the sludge from approximately 99 percent to about 75 percent.

The inert residue or ash produced in the incineration process must be disposed of on a landfill. Because incineration involves evaporation of the water content in the sludge, the residue contains no water and hence the volume to be disposed of would be relatively minor (10-20 percent) in comparison to the non-incinerated sludge. Approximately 14-30 acres of land would be needed over the 50-year life of the project depending on the level of wastewater treatment. This system pertains to all wastewater treatment alternatives considered, that is; secondary, secondary plus nitrification, biological AWT, and physical/chemical AWT.

Alternative B: Land Application.

Land application of sludge required: (1) gravity thickener; (2) anaerobic digestion; (3) hauling of the liquid sludge by tanker truck to a storage site; and (4) application of the sludge on agricultural land.

Thickening reduces the moisture content of the sludge and consequently the volume to be handled. Digestion reduces the volatile content of the sludge, and hence, the volume to be disposed of. Digestion also destroys pathogenic organisms associated with the sludge. Digestion was not used in the flow diagram for physical/chemical AWT as the volatile content would be too low and as the organic sludge could not be separated from the chemical sludge.

Regarding biological AWT, the sludges from the major unit processes could be easily separated. The one exception was the denitrification sludge which was insignificant in comparison to the primary and secondary sludge. Therefore, the flow diagram for biological AWT included digestion of the primary and secondary sludges and land application of these sludges together wwith the denitrification and chemical sludges.

The sludge would be hauled away without dewatering since it is more easily applied to the land and is more readily plowed into the soil by the farmer. Depending upon the level of wastewater treatment, approximately 1,770 to 2,825 acres of land would receive sludge application. As existing

agricultural land would be utilized, and as there appears to be a good demand for sludge as a soil conditioner, purchase of land would not be required.

Tank trucks would be used to haul the sludge because of its consistency (approximately 95 percent water). Storage of the sludge would also be required because of the seasonal nature of the application i.e., the growing season (April-September). Approximately 7 to 16 acres of land would be necessary for storage lagoons.

Alternative C: Landfill.

Alternative C included: (1) gravity thickener; (2) anaerobic digestion; (3) dewatering by vacuum filtration; and (4) hauling of the sludge by dump truck to a landfill site.

Again, the thickening and digestion processes would be used to reduce the amount of sludge to be handled. The digestion process could not be used for physical/chemical or denitrified sludges. Vacuum filtration, as stated previously, would reduce the moisture content to 75 percent, thus reducing the volume to be handled. Dump trucks would be used to haul the sludge to the landfill site. Over the 50-year project life, 226 to 425 acres of land would be purchased and committed to landfill, depending on the degree of wastewater treatment.

Cost Analysis

Tables V-26, V-27, and V-28 present both the capital and operating costs for the sludge management systems for three types of wastewater treatment in each service area. The capital costs reflect those unit processes which either need extentions or would be required as a complete addition to the treatment plant. Land costs associated with landfill disposal were computed at $500/acre which was representative of the area. Land costs were not included for land application since it was assumed existing farmland would be used. Because this alternative is reversible (because of the small capital commitment) it would not be necessary to purchase the land from the farmers. Approximately 7 acres, however, would be purchased for storage lagoons.

In order to determine the cost-effectiveness of each sludge handling alternative, the total average annual cost presented. Costs were based on a 50 year time scale and a 6 1/8% interest rate. Replacement costs were based on a 25 year useful life of each unit. Existing units were accounted for in computing the replacement cost.

TABLE V-26

ALTERNATIVE SLUDGE MANAGEMENT COSTS FOR SECONDARY TREATMENT PLANTS [1]
($1,000)

Service Area	ALTERNATIVES A Incineration	B Land Application [3]	C Landfill
Binghamton-Johnson City			
Capital	3,500	-	340
O & M	334	232	306
Average Annual [2]	639	250	362
Endicott			
Capital	760	-	100
O & M	91	45	88
Average Annual [2]	168	55	115
Chenango Valley			
Capital	990	460	815
O & M	74	34	71
Average Annual [2]	162	72	139
East Owego			
Capital	971	-	320
O & M	68	30	67
Average Annual [2]	153	38	102
West Owego & Owego Village			
Capital	840	-	225
O & M	57	24	56
Average Annual [2]	130	31	82
TOTAL			
Capital	7,061	460	1,800
O & M	624	365	588
Average Annual	1,252	446	800

[1] Including improved secondary systems, i.e., nitrification added.

[2] 50 years @ 6 1/8%; includes replacement @ 25 years.

[3] Existing agricultural land used rather than purchased.

TABLE V-27

ALTERNATIVE SLUDGE MANAGEMENT COSTS FOR BIOLOGICAL ADVANCED WASTE TREATMENT PLANTS ($1,000)

Service Area	ALTERNATIVES A Incineration	B Land Application[2]	C Landfill
Binghamton-Johnson City			
Capital	4,780	-	2,015
O & M	411	318	402
Average Annual [1]	822	336	601
Endicott			
Capital	1,230	-	166
O & M	150	84	147
Average Annual [1]	266	94	180
Chenango Valley			
Capital	1,230	460	950
O & M	91	70	92
Average Annual [1]	195	85	177
East Owego			
Capital	1,166	-	460
O & M	88	41	85
Average Annual [1]	186	50	137
West Owego & Owego Village			
Capital	970	-	316
O & M	65	32	69
Average Annual [1]	151	39	106
TOTAL			
Capital	9,376	460	3,907
O & M	805	545	795
Average Annual	1,620	604	1,201

[1] 50 years @ 6 1/8%; includes replacement @ 25 years.

[2] Existing agricultural land used rather than purchased.

TABLE V-28

ALTERNATIVE SLUDGE MANAGEMENT COSTS FOR PHYSICAL/CHEMICAL ADVANCED WASTE TREATMENT PLANTS ($1,000)

Service Area	ALTERNATIVES A Incineration	B Land Application[2]	C Landfill
Binghamton-Johnson City			
Capital	5,220	290	3,326
O & M	484	445	535
Average Annual [1]	943	477	834
Endicott			
Capital	1,213	213	413
O & M	139	89	153
Average Annual [1]	257	109	202
Chenango Valley			
Capital	1,315	84	747
O & M	90	40	103
Average Annual [1]	203	49	168
East Owego			
Capital	1,284	84	725
O & M	77	35	88
Average Annual [1]	186	44	150
West Owego & Owego Village			
Capital	1,122	76	600
O & M	69	26	76
Average Annual [1]	165	34	128
TOTAL			
Capital	10,154	747	5,811
O & M	859	635	954
Average Annual	1,754	713	1,482

[1] 50 years @ 6 1/8%; includes replacement @ 25 years.

[2] Applied to existing agricultural land rather than purchased.

As indicated in the tables, Alternative B, land application would be the least costly system for each level of treatment and for each service area. Alternative C, landfill, would be the next least expensive system, with costs significantly lower than Alternative A, incineration.

IMPACT ASSESSMENT AND EVALUATION

This section summarizes the impacts of the sludge handling alternatives on land, air, water, resource consumption, and resource production (see Impact Assessment and Evaluation Appendix for details). An evaluation table is provided (Table V-29) which analyzes each impact as to its beneficial, adverse, or no effect quality. The amount of consumptive land (land committed over the project life and precluded from other uses) and nonconsumptive land (continuance of existing land use) required for each alternative is given in Table V-30.

Incineration

Incineration would have adverse environmental impacts on the air quality and the resource consumption categories. The particulates emitted by the incinerator, although significant in comparison to the motor vehicle traffic, would lose their importance in comparison to the power plant emissions.

TABLE V-29

SLUDGE ALTERNATIVE IMPACT EVALUATION

Impact	A Incineration	B Land Application	C Landfill
Land	0	+	0
Air	-	0	0
Water	0	0	0
Resource Consumption	-	+	-
Resource Production	0	+	0

Key: + = beneficial
0 = no effect or not important
- = adverse

TABLE V-30

SLUDGE MANAGEMENT LAND REQUIREMENTS [1]

Impact	A Incineration	B Land Application	C Landfill
SECONDARY TREATMENT			
Consumptive Use-Acres [2]	14	7	226
Non-Consumptive Use-Acres [3]	-	1,771	-
BIOLOGICAL AWT			
Consumptive Use-Acres [2]	27	16	360
Non-Consumptive Use-Acres [3]	-	2,765	-
PHYSICAL/CHEMICAL AWT			
Consumptive Use-Acres [2]	30	16	425
Non-Consumptive Use-Acres [3]	-	2,825	-

[1] Based on 50 year project life.
[2] Purchased and Irretrievable
[3] Not purchased; existing agricultural land used.

However, the Binghamton area has been designated as an air quality maintenance area with the primary concern being suspended particulates. In light of this designation, any additional point sources of particulate emissions must not be taken lightly. The incineration process would also consume a considerable amount of natural resources including fuel, electricity, nutrients, and chemicals. These values would also lose their significance in comparison to the total consumption of these resources in the study area; however, in terms of environmental conservation, extensive use of these resources should be prevented if possible. Incineration would provide no beneficial impact as such and would produce no significant impacts concerning land and water.

Land Application

The beneficial impacts associated with land application would be the non-consumptive use of land and an improvement of this land by soil conditioning. However, 7 to 16 acres would be committed over the life of the project to provide storage during non-application periods. This commitment would be minor in comparison to the amount of irretrievable land used for landfill of dewatered sludge and would be one-half that used for disposal of incinerated ash.

Resource consumption would be minimized by eliminating the vacuum filter operation, and by the fertilizing effect of the nutrients from the sludge being recycled on farmland rather than wasted. The organic matter in the sludge would act as a soil conditioner by building up the humus material in the soil. The other major impacts categories involved, air and water, would be unaffected by land application.

Landfill

Landfill would also not provide any beneficial impacts and would have an adverse effect on resource consumption. This would be as a result of the vacuum filter operation and a non-productive use of the sludge itself. By hauling to a landfill, the nutritional value of the sludge would be lost. Landfill would not significantly effect the impacts regarding land, air, or water, and hence would be a slightly better alternative than incineration.

RECOMMENDATIONS

On an impact evaluation basis, land application was the clear choice for a sludge handling and disposal method, regardless of the level of treatment. Likewise, land application was also the chosen method derived from a cost-effective analysis. The farmland for sludge disposal is readily available (170,000 acres of agricultural land in Broome and Tioga Counties) and land application would in turn benefit the farmer (nutrients and organic content present in the sludge). However, the above considerations were given with certain reservations.

There does exist the potential for heavy metals build up in the soils and/or toxicity effects of the metals in plants. This may particularly apply to sludge from the Endicott STP which has been experiencing recent problems with heavy metals. Since work is currently being conducted on controlling this problem in the treatment plant, it was assumed this would not be the case in the future. Nitrate polluton of groundwater as a result of nitrification and subsequent leaching is also possible.

These two possibilities could be mitigated by selecting a correct application rate and strict monitoring at the site. The application rate utilized in the design (5 tons/acre/year) was based on the nitrogen uptake rate of particular crops (corn, grains) and should, therefore, prevent nitrogen pollution from occurring. Strict monitoring of the soil and crops for heavy metals build-up would mitigate heavy metal toxicity effects. In other words, monitoring would determine what the short term and long term effects are, if any, on the soil and crops. Modifications to the land application system could then be made (such as a change in application rate) if monitoring indicated a potential problem.

A potential odor problem could exist at the storage site, especially regarding the P/C AWT treatment systems (due to the undigested sludge). This impact can be mitigated in part by site location.

In summation, although potential impacts do exist for land application, these could easily be avoided or alleviated by the above mentioned suggestions.

The fact that litle capital expenditure would be involved for the land application alternative indicates this method would be an easily reversible system. That is: if problems do

arise which cannot be solved, another method of sludge handling could be implemented without much loss of money.

Because of the lower cost involved and the beneficial impacts associated with the land application of sewage sludge, the management committees for the Study recommended this method as the primary sludge disposal means for both Broome and Tioga Counties. Landfill of dewatered sludge was recommended as a back-up system should unavoidable problems arise with land application.

STAGE II - PUBLIC INVOLVEMENT

As the Study progressed and the committees became organized, a regular review procedure was established. After a report was issued, the Citizens Advisory Committee (CAC) and the Technical Advisory Committee (TAC) would meet one or more times to discuss and analyze the work. Recommendations for future Study direction were then made to the Interagency Study Management Group (ISMG) by both committees.

STAGE II-1

Report

The report for Stage II, Iteration 1, was sent to the Committees for review in September 1974. This document contained extensive information on the profile of the Bicounty Study Area; analyses of wastewater and stormwater management alternatives and their impacts; and a general assessment of the Outlying Communities (see Specialty Appendix).

Three CAC meetings were held to assess this report, review a newsletter, and prepare for the second public meeting. A TAC meeting was also held to review the report. The committees discussed the methodology used for selecting population projections, computing costs, and assessing social, economic, and environmental impacts.

The ISMG agreed to carry 12 alternatives plus the Baseline Condition. These included the 10 recommended by the TAC, an additional alternative proposed by the CAC, and one proposed by the Environmental Protection Agency. The last two additions were included in the event a minimum of 4 to 5 mg/l would be an acceptable DO level in the Susquehanna River.

First Newsletter

A subcommittee of the CAC was formed to assist the Corps in preparing and editing newsletters. The first newsletter was published in December 1974, describing the purpose of the Study and progress up to that time.

Public Meeting No. 2

The second public meeting was held on 30 January 1975 in Binghamton. One month prior to the meeting, an announcement was sent to about 1,500 interested individuals and organizations. Coverage of the meeting was also provided in local newspapers.

The CAC had independently publicized the meetng and provided information on the Study. The publicity subcommittees for the CAC distributed press releases to the media and recorded and sent spot announcements to radio stations. The CAC also prepared an editorial for the Sunday Binghamton Press and the Chairman of the CAC was interviewed for three television programs (from 5 to 15 minutes each).

The purpose of the public meeting was to present the alternatives recommended for further refinement. Suggestions and comments were invited from the approximately 110 people in attendance. The representatives of the Federal, State, and local agencies comprising the ISMG outlined the relationships between their agency and the Study. The CAC Chairman explained the role of the Citizens Committee and extended an invitation to everyone present to join the committee or express their preferences to any of the committee members.

STAGE II-2

Report

This report, distributed in March 1975, further refined the previous 13 alternatives and presented detailed analyses of four stormwater management systems.

Two CAC meetings and one TAC meeting were held to discuss this report.

The committees raised a number of questions about the impacts of providing a treatment plant in Chenango Valley. Also of concern, however, was the capability of the Binghamton-Johnson City system to handle both the Chenango Valley wastewater and normal wet weather flow. It was agreed that both regionalization schemes should be further analyzed.

Two alternatives providing only one plant for Tioga County were dropped by the CAC. These alternatives would have resulted in an interceptor crossing the river in a particularly unspoiled and attractive area. It was also suggested an alternative be considered that kept all treatment plants but added more nonstructural measures.

The proposed application of liquid sludge to farmland was of concern to members of the CAC as trace metals were found in sludge generated by the Binghamton-Johnson City plant. The consultant indicated more analysis would be performed on application rates and constituents.

The committees believed either microscreening or dissolved air flotation would be the best methods to treat combined sewer overflows provided they would meet stream standards. The TAC recommended seven alternatives for further refinement. Land treatment of wastewater did not warrant further consideration in their view.

The CAC also selected these same seven alternatives, but in addition, recommended that land treatment be further investigated. The ISMG agreed with the CAC and directed that all eight alternatives be carried forward for Stage III planning. Microscreening of combined sewer overflows was selected as a component for every action alternative.

Second Newsletter

The CAC and the Corps prepared a second newsletter late in May 1975, describing the progress of the Study through Stage II-2.

CHAPTER VI

STAGE III: REFINEMENT OF PLANS

The ultimate goal of the planning procedure was to formulate areawide plans for water quality improvement. Through the first two stages of the Study, analyses were conducted for various wastewater management components. These analyses were performed somewhat independently of each other. In Stage III-1, the various components were combined into comprehensive technical systems.

The first two stages investigated only the technical aspects of planning since outside constraints were not to influence the formulation of broad alternatives. However, to implement any plan it was necessary to examine the institutions responsible for wastewater management. Improvements in the existing arrangements were analyzed and evaluated for the implementation and management of each plan in Stage III-2. Each plan could then be considered as a total system addressing the many aspects and problems of complete wastewater management planning.

The final outcome of Stage III was the selection of four Plans for Choice with a recommendation made for implementation of one of these final plans.

PLAN COMPONENTS

In this Stage then, alternatives or components of alternatives selected by the management and advisory committees were formulated into complete plans. That is, each plan contained provisions for wastewater, stormwater, flow reduction, sludge, and for the final iteration, institutional arrangements. A complete wastewater management plan

provided systems or programs in each of the following categories:

a. Municipal Wastewater Treatment System: This included the facilities to provide treatment for wastewater including domestic, commercial, and industrial flows connected to municipal sewers, and was defined by the following characteristics:

- The number and location of treatment plants and their service areas (degree of regionalization).

- The level of infiltration control included.

- The level of flow reduction by nonstructural measures.

- The level of treatment provided.

b. Stormwater Management System: This included the facilities that would provide treatment for storm runoff and combined sewer overflows.

c. Sludge Management System: These facilities included the units utilized to process and dispose of the sludge generated in municipal wastewater treatment plants.

d. Institutional Analysis: Provided the management tool necessary to implement the above treatment systems.

STAGE III - ITERATION 1

PREVIOUS ALTERNATIVES

At the end of Stage II of the Study, the Interagency Study Management Group recommended eight municipal wastewater management alternatives for further analysis. One stormwater management system for the City of Binghamton and one sludge management scheme (with a backup alternative) were also recommended as components for each wastewater management alternative. The alternatives carried forward from Stage II-2 are given in Table VI-1.

TABLE VI-1

STAGE II RECOMMENDED ALTERNATIVES

Stage II-2 Alternative	Objective	Alternative Description*	Decision Component
1	Baseline	1977 Baseline Condition, Five plants (2+3) with secondary treatment	Baseline, for comparison
3b	5.0 mg/l DO	Four plants (2+2) with nitrification at Binghamton-Johnson City	Degree of Regionalization
5	5.0 mg/l DO	Six plants (3+3) with nitrification at Binghamton-Johnson City	
6	Biological AWT	Biological AWT - Five plants (3+2) Infiltration control at Binghamton	Type of AWT to be applied
7	P/C AWT	Physical/Chemical AWT - Five plants (3+2), infiltration control at Binghamton	
8b	Land Application	Seasonal land treatment - five plants (3+2); Non-structural measures and infiltration control at Binghamton	Effect of land application
11	Flow Reduction	Five plants (3+:) - Non-structural measures; infiltration control at Binghamton	Effect of flow reduction

TABLE V-1 (Continued)

Stage II-2 Alternative	Objective	Alternative Description	Decision Component
12b	4.0 mg/l DO	Six plants (3+3) - all secondary	Effect of 4.0 mg/l dissolved oxygen
B	Stormwater Management City of Binghamton	Micro-strainers	
B	Sludge Management	Land application of liquid sludge (Landfill as backup)	

*Note: The designation (a+b) refers to:

a: No. of STP's in Broome County
b: No. of STP's in Tioga County

REFINEMENTS AND MODIFICATIONS

This section describes the process by which the alternatives carried through from Stage II-2 were refined into complete plans.

Land Treatment

At the outset of this Iteration, the advisory committees recommended the seasonal land application plan include effluents from all the treatment plants. Earlier alternatives in Stage II investigated only partial land application with effluent from Chenango Valley and Endicott being discharged to surface waters. The result was difficult to evaluate in comparison to others and its effectiveness was felt to be too poorly defined.

Selection of Nonstructural Measures

A pricing system based on a metered rate and an education program to inform domestic users of the personal savings obtainable by installing water saving devices in the home were considered as the two nonstructural programs most likely to achieve significant flow reductions.

Estimates were made of the effectiveness of these measures in reducing flows and associated cost savings in treatment plant construction and operation, versus the economic costs borne by households installing water saving devices. An evaluation was made to determine the most effective degree of nonstructural measures for each level of treatment, i.e., secondary, improved secondary, land treatment, and advanced waste treatment. Table VI-2 presents the amount of flow that can be economically eliminated, and the percent achieved in attaining the nonstructural goal of maintaining present per capita flows throughout the planning period.

Other methods of achieving flow reduction by nonstructural measures include zoning and building codes, modifying the block rate structure for large water users, and industrial surcharges. These methods were not recommended for detailed analysis however, as they either would not effectively

TABLE VI-2

COST-EFFECTIVE LEVEL OF NONSTRUCTURAL MEASURES IN YEAR 1999[1]

Service Area and Treatment Level	Reduced Flow Pricing[2] (mgd)	Reduced Flow Education[3] (mgd)	Total Percent[4] Achievement
Binghamton-Johnson City			
Secondary	0	1.10	23
Improved Secondary (5 mg/l DO)	0.22	1.10	31
Biological AWT	1.61	1.26	62
Physical/Chemical AWT	2.28	1.26	75
Endicott			
Secondary	0	0.70	37
Biological AWT	0.86	0.78	86
Physical/Chemical AWT	1.35	0.78	100
Chenango Valley			
Secondary	0	0.21	46
Improved Secondary	0.03	0.21	53
Biological AWT	0.27	0.22	100
Physical/Chemical AWT	0.36	0.22	100
East Owego			
Secondary	0	0.18	35
Biological AWT	0.37	0.19	100
Physical/Chemical AWT	0.42	0.19	100
West Owego			
Secondary	0	0.08	33
Biological AWT	0.15	0.09	100
Physical/Chemical AWT	0.21	0.09	100
Owego Village			
Secondary	0	0.04	21
Biological AWT	0.14	0.05	100
Physical/Chemical AWT	0.20	0.05	100

[1] No increase in per capita flow projected after year 2000.
[2] Reduction in consumer demand due to pricing policy.
[3] Reduction in consumer demand due to education program to encourage home owners to install cost-effective plumbing devices that conserve water.
[4] Degree to which combined program achieves the non-structural goal of maintaining current per capita flow rates.

reduce flows or would result in social costs greater than the benefits. The investigation of nonstructural measures is presented in the Specialty Appendix.

The amount of flow reduction by a combined pricing and education program that is economical to apply depends upon the level of wastewater treatment. For example, it can be expected that the level of cost-effective nonstructural flow reduction would be greater for the AWT plan than for the secondary treatment level.

The direct cost to a wastewater management plan of such a combined program would be $30,000 to $40,000 per year over a period of seven to thirteen years. These costs are those of the education program. Since most of the region is already metered for water supply, there is no direct cost associated with pricing.

In conclusion, the recommended nonstructural program is pricing plus a low level education program to make individual consumers aware of the savings they can gain by flow reduction measures in the home.

Management of Stormwater for City of Binghamton

The stormwater management alternatives screened and evaluated in Stage II resulted in the selection of one system by the committees. All plans in this iteration included microstrainers and chlorination at five combined sewer overflow locations.

Management of Sludge

Several sludge management schemes were analyzed, compared, and evaluated. The application of liquid sludge to agricultural land (with landfill as a backup alternative) was included as a component of each plan. The sludge would be applied only in areas designated for agricultural use.

Service Areas for Sewage Treatment Plants

There were six urban wastewater management areas which this study considered for location of sewage treatment plants (STP's):

1. Binghamton-Johnson City
2. Endicott
3. East Owego
4. West Owego
5. Owego Village
6. Chenango Valley

The first four currently have a large investment in relatively new secondary STP's (1970's). Plans are underway to upgrade the Owego Village primary plant to a secondary treatment facility. Chenango Valley was considered because a need for sewerage exists and a feasibility study recommended a new secondary treatment plant for the area (Martin, 1975).

The Vestal facility is currently scheduled to be closed, and wastewater flows from this area and from Nanticoke Valley (presently unsewered) are to be delivered to the Endicott STP by 1977. Also by 1977, the Five Mile Point area is planned for sewerage with treatment at the Binghamton-Johnson City STP. Table VI-3 summarizes the major features of the six service areas and Figures VI-1, VI-2, and VI-3 locate their boundaries.

Population and Flow Projections

Based on the availability of new information, changes in population and flow projections were made for three of the service areas: Chenango Valley, West Owego, and Owego Village. In the first two service areas, particularly West Owego, major reductions were made in the population projections, and therefore, the design wastewater flows.

TABLE VI-3

SERVICE AREAS

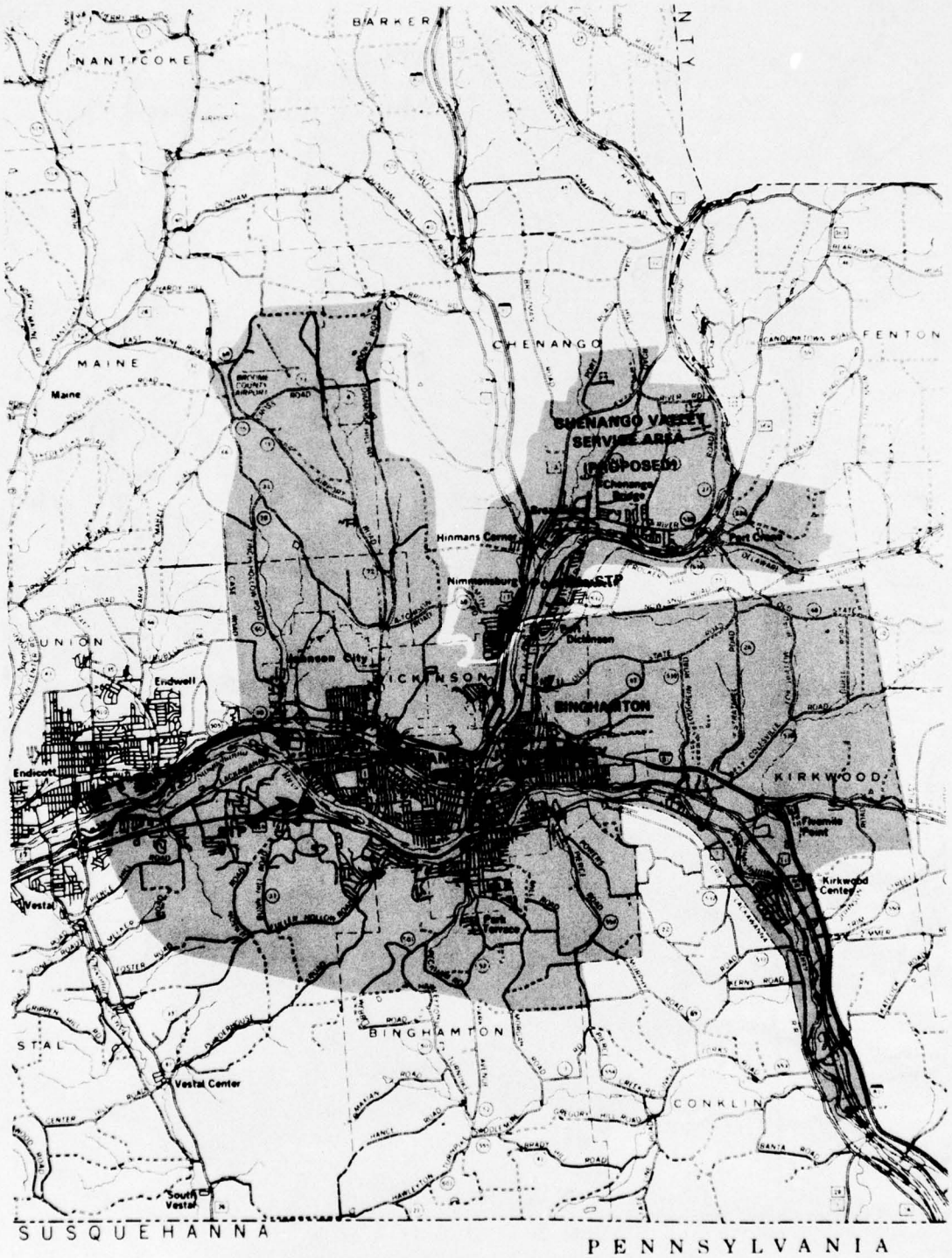
STP Service Area	County	Existing Sewage Treatment	Major Place Names Included
Binghamton-Johnson City	Broome	B-JC STP Secondary treatment (activated sludge)	City of Binghamton, Town of Binghamton, Kirkwood, Port Dickinson, Dickinson, Johnson City, Westover, Portions of Vestal
Chenango Valley	Broome	None (no sewers existing)	Broadacres, Chenango Bridge, Fenton-Kattellville, Nimmonsburg, Sunrise Terrace
Endicott	Broome	a. Endicott STP secondary treatment	Endicott, Town of Union (except Westover)
		b. Vestal STP primary treatment	Most of Vestal
East Owego (STP #2)	Tioga	Town of Owego STP #2 Secondary Treatment (activated sludge)	Eastern Portions of Town of Owego
West Owego (STP #1)	Tioga	Town of Owego STP #1 Secondary Treatment (trickling filter)	Western portions of Town of Owego
Owego Village	Tioga	Owego (V) STP Primary treatment (to be upgraded to secondary in Baseline Plan)	Owego Village, Valley View

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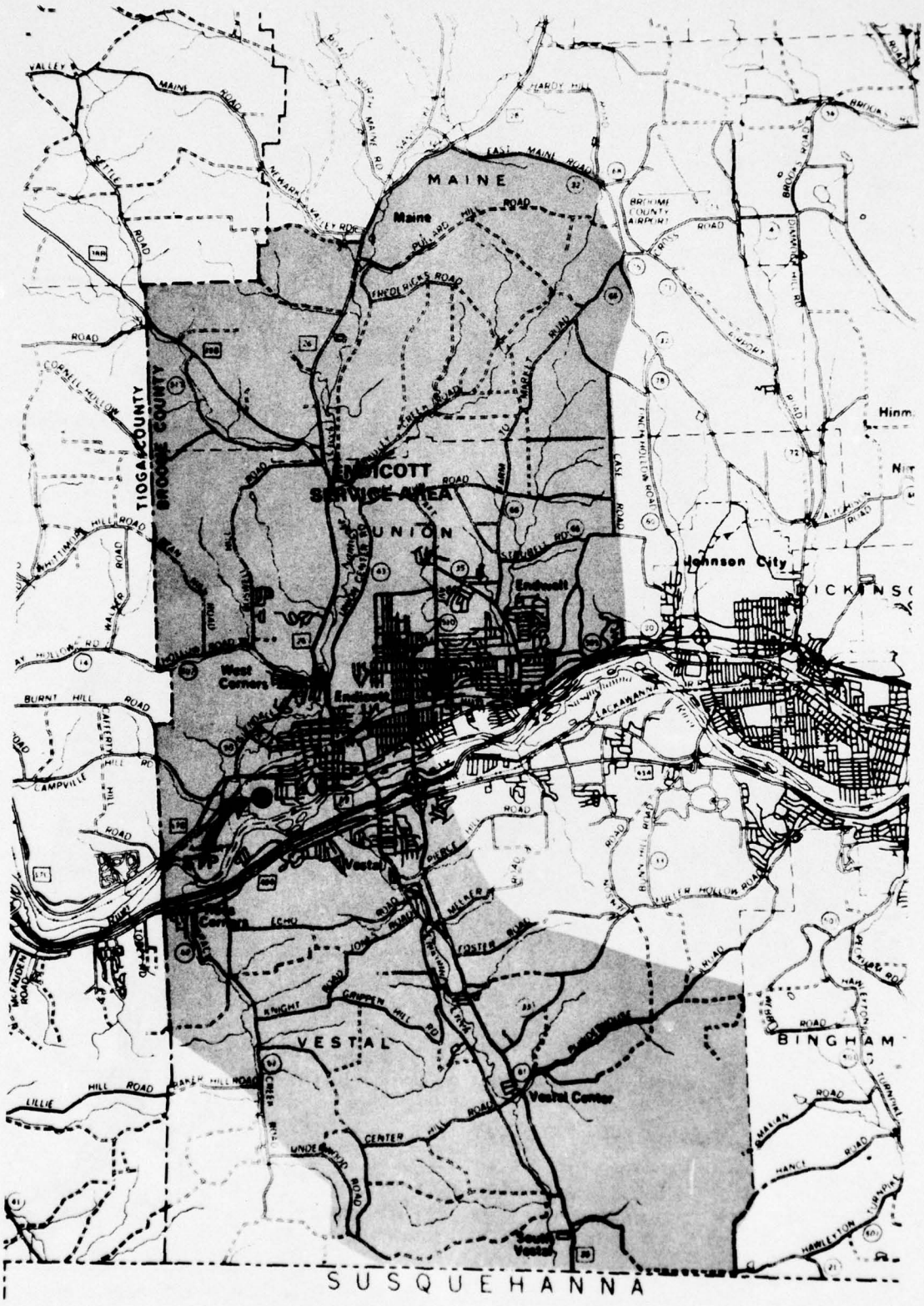
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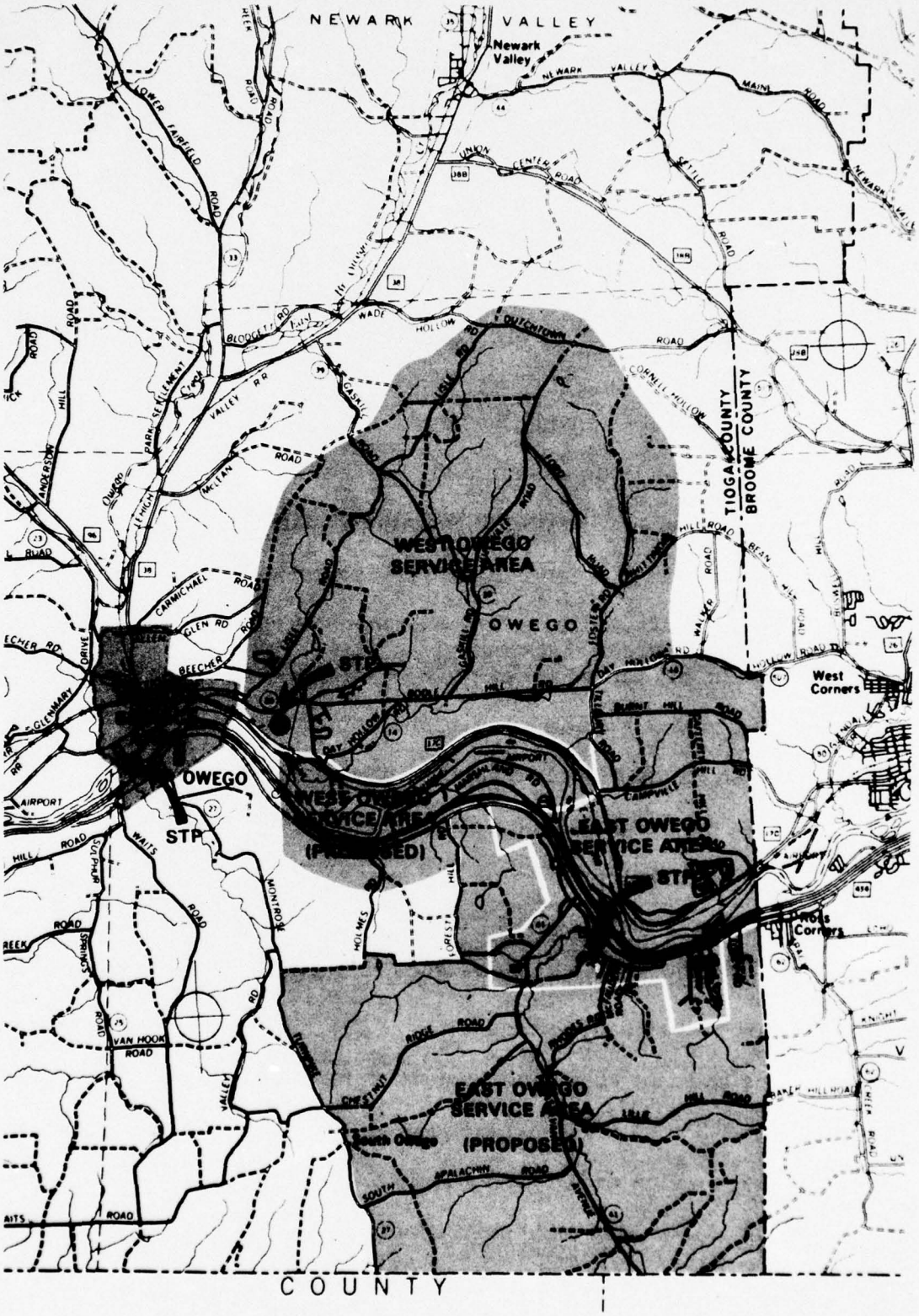


BINGHAMTON-JOHNSON CITY SERVICE AREA
CHENANGO VALLEY SERVICE AREAS

FIGURE VI-1



ENDICOTT SERVICE AREA **FIGURE VI-2**



OWEGO SERVICE AREAS **FIGURE VI-3**

West Owego and Chenango Valley.

Previous projections assumed all service area population would be sewered. In the Binghamton-Johnson City, Endicott, East Owego, and Owego Village service areas, the proportion of the total population which is unsewered is quite small. Therefore, the initial assumption of 100% sewering was not modified in these areas because the somewhat optimistic projection had negligible impact on the total population projections. In the Chenango Valley and West Owego areas, the opposite (a larger proportion of unsewered population) was true, so the 100% sewering assumption was modified to better estimate the required treatment system capacities. This resulted in a significant reduction of Chenango Valley projections and in a very large reduction for West Owego projections. These lower projections also tended to favor subregionalization schemes for each service area (particularly for West Owego and Owego Village) rather than regionalization.

The service area boundary for Chenango Valley was also changed. The R. J. Martin Report "Amendment to Broome County Comprehensive Sewer Service Plan," March 1975, studied the feasibility of providing a new treatment plant at Chenango Valley. The service area boundary used previously was changed to conform to that shown in the R. J. Martin Report to provide uniformity and consistency to Study Area plans. The population and flow projections were reduced accordingly to reflect the smaller service area used in the Martin report.

Analysis of flow records plus discussions with operating personnel revealed that infiltration was a significant problem in West Owego in the early 1970's. However, infiltration is expected to be reduced to negligible levels by 1977, the start of the planning period. Thus, this flow was deducted from the projections and no cost for correction assigned during the planning period (1977-2020). Also, in West Owego, some future commercial and industrial expansion was assumed on the south side of the river.

Owego Village.

Infiltration and inflow represent a large part of the flow to the Owego Village plant as indicated by flow records and discussions with Village officials. The amount of infiltration is estimated to be in the order of 0.5 mgd. As a result, the per capita residential contribution was reduced to 71 gallons per capita per day (gpcd) with 0.5 mgd added to all projections to allow for present infiltration.

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In the Valley View portion of the Owego Village service area, a per capita flow of 60 gpcd and an infiltration rate of 25,000 gallons per day (0.025 mgd) was assumed.

Based on limited information, it was not possible to estimate the costs of correcting the infiltration for the Owego Village system. It was assumed correction would not be performed and the plant would continue to receive this excess flow.

It is also apparent from plant records that inflow to the Village plant is significant with total flows up to 3 mgd on a daily basis and peak flows even higher. Some of this excess flow is from small creeks entering the sewer system during storms. A brief analysis was made of the costs for separating the combined sewers or microscreening the amount of stormwater in excess of plant capacity. Microscreening is far less expensive, and as this was the recommended method for combined sewer overflows in Binghamton, it was also analyzed for the Owego Village system. Based on discussions with Village officials, the small creeks which flow into the system can be diverted at a minimal cost.

From the changes discussed above, new population and sewage flow projections were made. Table VI-4 presents the projections for sewered population. Table VI-5 presents the projection for flows with no reductions; and Table VI-6 for flows assuming nonstructural measures could prevent future increases in per capita generating of wastewater.

TABLE VI-4

STAGE III POPULATION PROJECTIONS
(Sewered Population)

SERVICE AREA	Population in 1,000's 1973	1980	2000	2020
Binghamton-Johnson City	102.0	107.7	109.2	113.4
Five Mile Point [1]	-	8.4	9.5	10.4
Total Service Area		116.1	118.7	123.8
Endicott	44.7	45.0	45.1	45.7
Vestal [2]	7.5	17.0	21.5	21.8
Nanticoke Valley [2]	-	5.6	7.0	7.7
Total Service Area		67.6	73.6	75.2
Chenango Valley	-	16.0	19.0	21.0
East Owego	6.5	13.5	18.9	21.3
West Owego	0.6	0.8	3.4	4.4
Owego Village [3]	3.6	4.9	4.6	5.0
Valley View	0.5	-	-	-
Total Urban Study Area	165.4	218.9	238.2	250.7

[1] Included in Binghamton-Johnson City service area by 1977.

[2] Included in Endicott service area by 1977.

[3] Includes Valley View area by 1977.

TABLE VI-5

STAGE III WASTEWATER FLOW PROJECTIONS (mgd)

SERVICE AREA	1973	1980	2000	2020
Binghamton-Johnson City[1]	18.3	20.8	23.2	23.9
Five Mile Point[2]	-	0.8	1.3	1.5
Total Service Area		21.6	24.5	25.4
Endicott[3]	4.2	4.4	5.1	5.1
Vestal[4]	1.0	2.3	3.3	3.5
Nanticoke Valley[4]	-	0.4	0.5	0.6
Total Service Area	-	7.1	8.9	9.2
Chenango Valley	-	1.5	2.0	2.2
East Owego	0.4	1.2	2.5	2.8
West Owego	0.2	0.2	0.5	0.7
Owego Village[5]	0.9	0.9	0.9	1.0
Total Urban Study Area	25.0	32.5	39.3	41.3

[1] Includes average daily infiltration of 7.5 mgd.

[2] Included in Binghamton-Johnson City service area by 1977.

[3] Includes average daily infiltration of 0.7 mgd.

[4] Included in Endicott service area by 1977.

[5] Includes 0.5 mgd wet weather infiltration.

TABLE VI-6

STAGE III LOW FLOW PROJECTIONS WITH NONSTRUCTURAL MEASURES (mgd) [1]

Service Area	1973 Flow	1980 Amount Reduced	1980 Flow	2000 Amount Reduced	2000 Flow	2020 Amount Reduced	2020 Flow
Binghamton-Johnson City [2]	18.9	1.2	19.6	3.4	19.8	3.7	20.2
Five Mile Point [3]	-	0.1	0.7	0.3	1.0	0.3	1.2
Total Service Area	-	1.3	20.3	3.7	20.8	4.0	21.4
Endicott [4]	4.2	0.3	4.1	0.9	4.2	0.9	4.2
Vestal [5]	1.0	0.2	2.1	0.7	2.6	0.8	2.7
Nanticoke Valley	-	0.0	0.4	0.1	0.4	0.2	0.4
Total Service Area	-	0.5	6.6	1.7	7.2	1.9	7.3
Chenango Valley	-	0.1	1.4	0.4	1.6	0.4	1.8
East Owego	0.4	0.1	1.1	0.5	2.0	0.6	2.2
West Owego [6]	0.2	0.0	0.2	0.1	0.4	0.1	0.6
Owego Village	0.9	0.0	0.9	0.0	0.9	0.1	0.9
Total Urban Study Area	25.0	2.0	30.5	6.4	32.9	7.1	34.2

[1] No increase in current per capita flows.

[2] Includes 7.5 mgd average daily infiltration.

[3] Included in Binghamton-Johnson City service area by 1977.

[4] Includes 0.7 mgd average daily infiltration.

[5] Included in Endicott service area by 1977.

[6] Includes 0.5 mgd wet weather infiltration.

Infiltration Control

The costs of infiltration control for the City of Binghamton system have been evaluated in this iteration. Because of the cost savings and environmental benefits, an economically efficient level of infiltration control has been defined for each plan. Infiltration control in other service areas was not included as costs could not be established.

The cost for control of infiltration in the City of Binghamton, broken down into nine separate projects, was taken from an infiltration/inflow analysis (Schumaker, 1974) study. A curve showing the cost of infiltration control versus the flow reduction achieved is presented in Figure VI-4. This curve was used in the cost-effectiveness analysis to determine the degree of infiltration control economically achievable for each of the plans.

Location of Chenango Valley STP

Initially, there were three possible sites for the location of the Chenango Valley plant proposed by R. J. Martin, Consulting Engineer. (Martin's analysis addressed the issue of whether Chenango Valley should treat its own wastes separately or send its wastes for treatment at the Binghamton-Johnson City STP). Based on environmental considerations, primarily with regard to compatability with adjacent land uses, only one of these sites was considered suitable, and was used as the site in the design of a separate Chenango Valley STP. The site, shown in Figure VI-1, is the same one which was the final choice of R. J. Martin (1975).

Selection of Interceptor Routes

Interceptor routes were selected in the field by coordination between a design engineer and an environmental assessor. Within reasonable limits of economics, interceptor routes were selected to avoid such sensitive areas as commercial areas, roads, stream corridors, wetlands, and mature forests.

CAPITAL COST OF INFILTRATION CONTROL IN BINGHAMTON-JOHNSON CITY SERVICE AREA

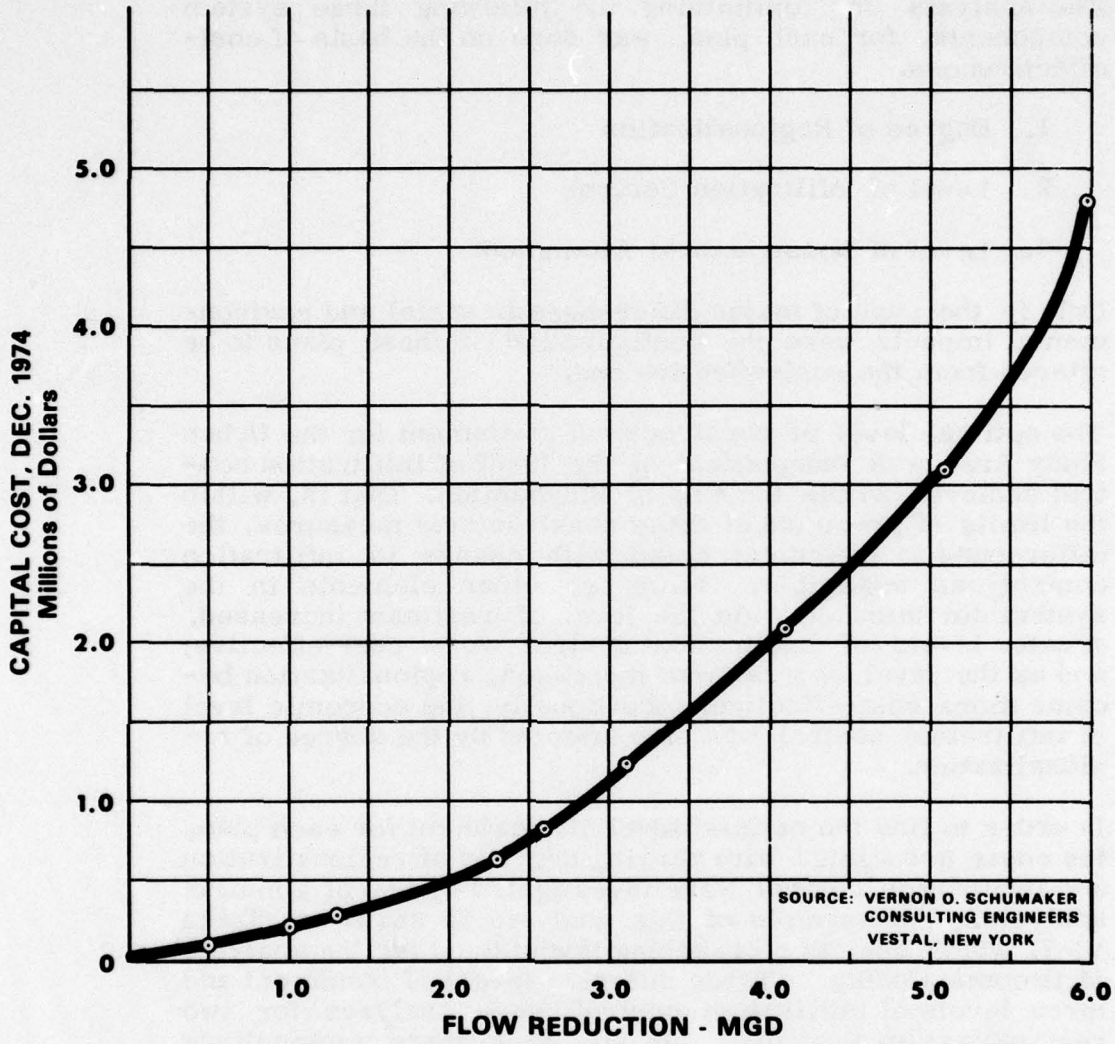


FIGURE VI-4

Optimization of Components

The analysis for optimizing the following three system components, for each plan, was done on the basis of cost-effectiveness.

1. Degree of Regionalization
2. Level of Infiltration Control
3. Level of Nonstructural Attainment

Only in the case of major differences in social and environmental impacts were the configuration of these plans to be altered from the cost-effective one.

The optimal level of nonstructural attainment for the Urban Study Area was independent of the level of infiltration control achieved within the City of Binghamton. That is, within the limits of precision of these nonstructural measures, the differences in treatment costs with change in infiltration control was negligible. However, other elements in the system did interact. As the level of treatment increased, greater levels of infiltration control were cost-effective; and as the level of treatment increased, regionalization became more cost-effective. Additionally, the economic level of infiltration control was also affected by the degree of regionalization.

In order to find the optimal level of treatment for each plan, the costs associated with varying degrees of regionalization and infiltration control were investigated by use of a matrix analysis. An example of this analysis is shown on Table VI-7, which depicts a branching layout used for the analysis of Broome County. Three different levels of treatment and three levels of infiltration control were analyzed for two regionalization systems. In all, 81 system combinations were analyzed in Broome County.

The optimal degree of regionalization and infiltration control for each level of treatment was the combination resulting in the least present worth.

The analysis for Tioga County was similar except that infiltration control did not vary. Thus, the optimal degree of regionalization was determined for each level of treatment in each county and the results are summarized in Table VI-8.

TABLE VI-7

TYPICAL DECISION STRUCTURE FOR OPTIMIZING COMPONENTS

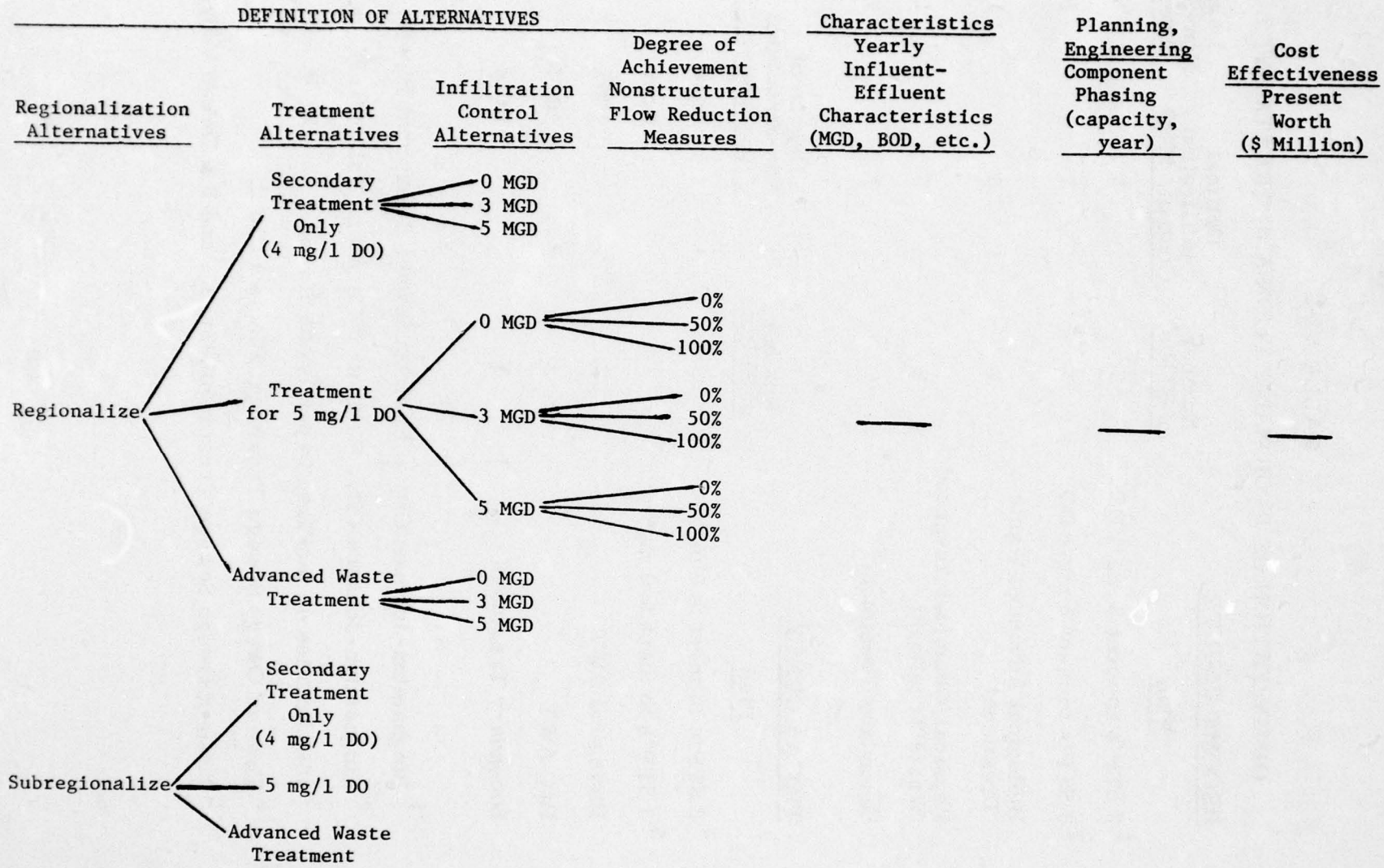


TABLE VI-8

OPTIMIZATION OF REGIONALIZATION AND TREATMENT LEVEL

BROOME COUNTY Plan	Number of STP's	Optimal Infiltration Control, MGD	Degree of Non-Structural Attainment [3]
[1] 2 STP's to meet 5 mg/l DO	2	3	None
[2] 3 STP's to meet 5 mg/l DO	3	3	None
Biological Advanced Waste Treatment	2	3	100%
Physical/Chemical Advanced Waste Treatment	2	5	100%
Secondary Treatment	2	1	None

TIOGA COUNTY Plan	Number of STP's	Degree of Non-Structural Attainment
[4] 2 STP's to meet 5.0 mg/l	2	None
[5] 3 STP's to meet 5.0 mg/l	3	None
Biological AWT	2	100%
P/C AWT	2	100%
Secondary Treatment	3	None

[1] Binghamton-Johnson City & Endicott Sewage Treatment Plants.

[2] Binghamton-Johnson City, Endicott & Chenango Valley STP's.

[3] 100% implies no increase in per capita flows.

[4] Town of Owego Sewage Treatment Plants 1 and 2.

[5] Town of Owego Sewage Treatment Plants 1 and 2 & Owego Village.

Based on a cost comparison, the optimal regionalization scheme for advanced waste treatment systems was two plants in Broome County and two in Tioga County. For secondary treatment, two plants in Broome and three in Tioga was selected. Three degrees of regionalization were carried forward for plans achieving a DO level of 5 mg/l (improved secondary). The above results were based solely on cost-effectiveness by comparing total present worth values of capital, O & M, and replacement costs.

Two more decisions were required that were based on cost-effectiveness and social and environmental impacts:

a. The degree of regionalization, amount of infiltration control, and nonstructural flow reduction in the Land Treatment Plan;

b. The degree of regionalization and level of infiltration control to be included with the Flow Reduction Plan (for maintenance of zero increase in per capita flows by nonstructural measures).

With reference to the Land Treatment Plan, the optimal degree of regionalization in Broome County can be inferred from the analysis just described, i.e., at all levels of treatment investigated, the most cost-effective scheme was treatment of Chenango Valley wastewater at the Binghamton-Johnson City plant. Additionally, the closest application site to Chenango Valley was the same site best suited for Binghamton-Johnson City. Therefore, all the connecting pipe required of a two plant scheme was needed for the land application with a three plant scheme. Economy of scale for land treatment clearly indicated that regionalization at two plants in Broome County was cost-effective. Treatment of Owego Village wastewater at West Owego was also recommended based on analyses of Tioga County. Suitable application sites were closer to West Owego than to Owego Village.

The level of nonstructural and infiltration flow reduction to be attained in the land application plan was derived from the cost-effectiveness analysis and the ISMG decision at the end of Stage II to reduce the land area to as little as possible. The analysis of nonstructural measures showed that, for the AWT alternatives, attainment of 100% non-structural flow reduction (no increase in per capita flows) was cost-effective in five of the six service areas, and attainment of high levels of infiltration control were also cost-effective. Although this analysis was not rigorously pursued, it was felt that the special characteristics of the land treatment system warranted the full attainment of flow reduction potentials.

Similar reasoning was applied the amount of flow reduction to be achieved in the Flow Reduction Plan. The cost-effective level of nonstructural attainment was not strictly adhered to, since the purpose of this Alternative was to analyze the benefits to be achieved by maximum nonstructural flow reduction. Examination of the results of the Broome County regionalization matrix indicated that it was cost-effective to treat Chenango Valley's wastes at the Binghamton-Johnson City STP. At this degree of regionalization, and the specified 100 percent attainment of nonstructural flow reduction, the cost-effective level of infiltration control was 1.0 mgd. However, the penalty in present worth, for going beyond the economical amount of infiltration control, to 3 mgd control, was fairly small ($0.4 million present worth) in comparison to the additional $1.3 million required to achieve 5.0 mgd infiltration control. Considering this small difference, and the stated intention of this plan to analyze the benefits of flow reduction, the greater degree (3 mgd) of infiltration control was selected. The cost-effective degree of regionalization was found to be treatment of Chenango Valley wastewater at Binghamton-Johnson City and separate treatment plants for West Owego and Owego Village.

Summary of Revisions

Based on the modifications previously discussed, changes made from the alternatives recommended at the end of Stage II-2 are presented in Table V-9.

DESCRIPTION OF PLANS

Plan I - 1977 Baseline Plan

As previously stated, the 1977 Baseline Plan was used to establish the basis for the impact assessment of the other "action" plans. This basis portrays the impacts which would result (by year 2020) if the Urban Study Area's wastewater management systems remained unchanged from those planned for the year 1977. This plan consisted of a static physical system subjected to the future population growth

TABLE VI-9

RELATIONSHIP BETWEEN STAGE II-2 ALTERNATIVES AND STAGE III-1 PLANS

Alternative Number	Objective	Features[1]	Plan Number	Changes	Rationale
1	provide baseline for assessment		1	No change	
3b	provide basis for regionalization assessment (w/Alt. 5)	2+2 STP's 5.0 mg/1 DO	2	3.0 mgd infiltration control	Cost-effective
5	provide basis for regionalization assessment	3+3 STP's 5.0 mg/1 DO	3	3.0 mgd infiltration control	Cost-effective
6	Biological AWT	3+2 STP's 5 mgd infiltration control	4	2+2 STP's non-structural 3 mgd infiltration control	Cost-effective
7	Physical/Chemical AWT	3+2 STP's 5 mgd Infiltration control	5	2+2 STP's non-structural	Cost-effective
8b	Land Treatment	3+2 STP's Chenango Valley + Endicott: no land application 5 mgd infiltration control; non-structural	6	2+2 STP's Apply all sewage to land (seasonal)	Cost-effective provide better basis for assessment and evaluation

TABLE VI-9 (Continued)

Alternative Number	Objective	Features[1]	Plan Number	Changes	Rationale
11	Maximum flow reduction, meet 5.0 mg/1 DO	3+2 STP's 5.0 mgd infiltration control non-structural	7	2+3 STP's 3.0 mgd infiltration control	Cost-effective close to cost-effective
12a	Minimum cost to meet 4.0 mg/1 DO	2+3 STP's secondary treatment only no flow reduction	8	1.0 mgd infiltration control	Cost-effective

[1] "2+2 STP's" refers to number of sewage treatment plants in Broome County and Tioga County, respectively.

and flow increases projected for the area. The minimum DO level in the Susquehanna River would be 3-4 mg/l during dry weather flows and possibly lower during certain storm conditions.

In defining the environmental, social, and economic projections for the Baseline Plan, it was assumed that no wastewater treatment plants would be added or other than those that have already been approved by NYSDEC for construction by 1977. Expansion of existing service areas would continue following the existing trends. The additional interceptors approved by NYSDEC for funding by 1977 were included in the 1977 Baseline Condition. However, the Chenango Valley interceptor was not included in these conditions, since Broome County was studying other alternatives. The interceptors providing service for growth areas that were included in the Broome County Sewerage Feasibility Study were assumed to be in the 1977 Baseline Plan.

In summary, the wastewater management plans for the 1977 Baseline Plan included:

1. Abandonment of the Vestal STP and diversion of its influent sewage via a new interceptor to the Endicott STP.

2. Upgrading the Owego Village STP to provide secondary treatment.

3. Abandonment of the Owego Valley View STP and diversion of its influent sewage to an upgraded Owego Village STP.

4. The remaining existing STP's, including Binghamton-Johnson City STP, Town of Owego STP No. 2 (East Owego), Town of Owego STP No. 1 (West Owego), and Endicott STP would not be expanded or upgraded.

5. The Chenango Valley area would continue on septic systems.

6. Extension of sewage collection and treatment services would take place within the Nanticoke Creek Valley and toward Five Mile Point.

7. The sewered population of all STP's would continue to grow and sewage flows would increase.

The present worth of total costs (capital, operation and maintenance, and replacement) to the year 2020 would be $32.6 million, of which $24 million represented the local share (based on current cost sharing arrangements).

Plan 2 - Two Plants, Broome; Two Plants, Tioga Nitrification at Binghamton-Johnson City

The objective of this alternative was to define a least cost wastewater management system that would maintain a minimum DO of 5 mg/l during low river flow periods and above 4 mg/l during storm overflow conditions.

This alternative included two STP's at Broome County and two STP's at Tioga County. The Broome County plants would be at the existing Binghamton-Johnson City and Endicott STP's. Chenango Valley wastewater flow would be treated at Binghamton-Johnson City STP. Tioga County plants would be at Town of Owego STP's Nos. 1 and 2.

To maintain a 5 mg/l minimum DO level in the Susquehanna River, secondary treatment plus nitrification would be applied to the Binghamton-Johnson City STP by the year 1994. Secondary treatment only would be sufficient at the other three STP's.

Investigation of various infiltration control levels indicated the economically justifiable level in the City of Binghamton was 3 mgd. Sewer rehabilitation to control infiltration was recommended by 1977.

Microscreening devices followed by chlorination facilities would be provided at the major overflow sites by 1980. A more detailed description of these facilities is included in Chapter V.

A detailed analysis of sludge management techniques is summarized in Chapter V. It was recommended that land application of liquid sludge be utilized.

The present worth of total costs (capital, operation, maintenance, and replacement) to the year 2020 would be $44.3 million of which $30.7 million represented the local share.

Plan 3 - Three Plants, Broome; Three Plants, Tioga Nitrification at Binghamton-Johnson City

The objective of this plan was to define a minimum cost wastewater management system that would maintain a minimum DO of 5 mg/l during low flow periods and above 4 mg/l

during storm overflow conditions. Nonstructural measures for flow reduction were not included in this alternative.

This plan included three STP's at Broome County and three STP's at Tioga County. The Broome County plants would be at Binghamton-Johnson City, Endicott, and Chenango Valley. The Tioga County STP's would be at the Town of Owego STP No. 1, Town of Owego STP No. 2, and Village of Owego.

To maintain a 5 mg/l minimum do level in the Susquehanna River during low flow conditions, addition of nitrification facilities to the existing secondary treatment at the Binghamton-Johnson City STP would be required by the year 1994. Secondary treatment would be sufficient at the other 5 STP's.

Investigation of various infiltration control levels indicated that the economically justifiable flow reduction in the Binghamton-Johnson City Service Area was 3 mgd. Sewer rehabilitation to control infiltration was recommended by 1977.

Microscreening devices followed by chlorinating facilities would be provided at the major overflow sites by 1980. A more detailed description of these facilities is included in Chapter V.

A detailed analysis of sludge management techniques is also summarized in Chapter V. It was recommended that land application of liquid sludge be utilized.

The present worth of total costs (capital, operation, maintenance, and replacement) to the year 2020 would be $45.8 million, of which $28.6 million represented the local share.

An alternative discharge pipe route from the Chenango Valley treatment plant was also considered. This alternative would provide an effluent outfall from the plant upstream of the Route 81 River Park. The originally proposed outfall would discharge downstream of the park, over 1 mile from the proposed treatment plant. The savings for the short outfall would be $700,000 and this savings would result in the subregional approach to Broome County wastewater management being more competitive with regionalization (treating Chenango Valley wastewater at Binghamton-Johnson City). The trade-off for the $700,000 saving was, of course, that a sewage outfall would be directly upstream of the park. However, dilution of the effluent should not normally fall below 40 to 1.

Plan 4 - Biological Advanced Waste Treatment

This plan provided for the application of best practicable waste treatment technology (BPWTT) by the year 1983 and advanced waste treatment (AWT) technology by the year 1985 at all municipal wastewater treatment plants to achieve the zero discharge goal of Public Law 92-500. The AWT processes used in this alternative were biologically based. The minimum DO level in the Susquehanna River would be 6-7 mg/l during low flow periods and above 5 mg/l during storm overflow conditions.

This plan included two STP's at Broome County and two STP's at Tioga County. The Broome County plants would be at the existing Binghamton-Johnson City and Endicott sites. The Tioga County STP's would be at Town of Owego STP Nos. 1 and 2.

The selection of these regionalization schemes was based on the economies of scale of AWT systems. The application of the methodology discussed previously indicated the minimum cost regionalization scheme was the one that provided for treatment of Chenango wastewater at Binghamton-Johnson City and treatment of Owego Village wastewater at the Owego No. 1 STP.

At each of the four plants, BPWTT would provide for the nitrification of secondary effluent by 1983 while AWT would provide for denitrification, phosphorus removal, filtration, and carbon adsorption by 1985.

Investigation of various infiltration control levels indicated the economically justifiable infiltration flow reduction was 3 mgd. Sewer rehabilitation to control infiltration was recommended by 1977.

Analysis of the application of nonstructural measures indicated that implementing a water pricing system and a public education program to maintain the current per capita wastewater generation were cost-effective.

Microscreening devices followed by chlorinating facilities would be provided at the major overflow sites by 1980. A more detailed description of these facilities is included in Chapter V.

A detailed analysis of sludge management techniques is also summarized in Chapter V. It was recommended that land application of liquid sludge be utilized.

The present worth of total costs (capital, operation, maintenance, and replacement) to the year 2020 would be $81.9 million, of which $47.8 million represented the local share.

Plan 5 - Physical/Chemical Advanced Waste Treatment System

This plan provided for the application of AWT by the year 1985 to achieve the zero discharge goal of Public Law 92-500. This alternative suggested proceeding directly from secondary treatment to AWT in the year 1985 as compared to Plan No. 4 which proceeded from secondary to BPWTT by the year 1983 and then AWT by the year 1985.

The objective of doing this was to indicate which pathway to the 1985 goal served the Federal and local interests from a financial viewpoint, as well as from an environmental and social viewpoint. A minimum DO level of 6-7 mg/l would be maintained in the Susquehanna River during low flow periods and above 5 mg/l during storm overflow conditions.

This plan included two STP's at Broome County and two STP's at Tioga County. The Broome County plants would be at the existing Binghamton-Johnson City and Endicott plants. The Tioga County STP's would be at the Town of Owego STP's Nos. 1 and 2.

The selection of these regionalization schemes was based on the economies of scale of AWT systems. The application of the methodology discussed previously indicated that the minimum cost regionalization scheme was the one that provides for treatment of Chenango Valley wastewater at Binghamton-Johnson City and treatment of Owego Village wastewater at Owego STP No. 1.

The physical/chemical based AWT scheme, to be applied to each of the four municipal STP's, involved four major treatment processes. These were alum addition to the primary clarifier, breakpoint chlorination, filtration, and activated carbon adsorpton.

Investigation of various infiltraton control levels indicated that the economically justifiable infiltration flow reduction was 5 mgd. Sewer rehabilitation to control infiltration was recommended by 1977.

Analysis of the application of nonstructural measures indicated that implementing a water pricing system and a public education program to maintain the current per capita wastewater generation were cost-effective.

Microscreening devices followed by chlorination facilities would be provided at the major overflow sites by 1980. A more detailed description of these facilities is included in Chapter V.

A detailed analysis of sludge management techniques is also summarized in Chapter V. It is recommended that land application of liquid sludge be utilized.

The present worth of total costs (capital, operation, maintenance, and replacements) to the year 2020, would be $84.3 million of which $48.4 million represented the local share.

Plan 6 - Land Treatment System

This alternative provided for seasonal land treatment of the wastewater effluents from all the municipal wastewater treatment plants by 1985. Spray irrigation systems would be operated in the May through October period while the secondary effluent would be discharged directly to the Susquehanna River during November through April period. A minimum DO level of 6-7 mg/l would be maintained in the Susquehanna River during low flow periods and above 5 mg/l during storm overflow conditions.

This plan included two STP's at Broome County and two STP's at Tioga County. The Broome County Plants would be at the existing Binghamton-Johnson City and Endicott sites. The Tioga County STP's would be the Town of Owego STP No. 1 and the Town of Owego STP No. 2.

The selection of the regionalization scheme was based on the available sites for land application of effluent and on a cost effectiveness analysis.

The secondary effluent from the Binghamton-Johnson City and the Endicott STP's would be applied at Site No. 2. The effluent from the Town of Owego STP No. 1, and the Town of Owego STP No. 2 would be at Sites No. 5a and 5b, respectively. Land application sites are shown in Plate No. 1. Municipal wastewater would receive secondary treatment and chlorination before application to land.

To minimize the required land for treatment, the optimum reduction of infiltration flow was an average of 5 mgd. Sewer rehabilitation to control infiltration is recommended by 1977. It was also recommended that nonstructural measures for flow reduction be implemented to maintain the current per capita wastewater, in order to minimize land requirements and associated costs.

Microscreening devices followed by chlorination facilities would be provided at the major overflow sites by 1980. A more detailed description of these facilities is included in Chapter V.

A detailed analysis of sludge management techniques is also summarized in Chapter V. It was recommended that land application of liquid sludge be utilized.

The present worth of total costs (capital, operation, maintenance, and replacement) to the year 2020 would be $69.4 million, of which $36.4 million represented the local share.

Plan 7 - Flow Reduction

The objective of this plan was to define a minimum cost wastewater management system that would maintain a DO level above 5 mg/l in the Susquehanna River during low flow periods and above 4 mg/l during storm overflow conditions, by application of flow reduction measures. This flow reduction would be achieved by applying the cost-effective level of infiltration control, and 100 percent achievement of nonstructural measures (to maintain current per capita flows) by water pricing and an educational program.

This plan included two STP's at Broome County and three STP's at Tioga County. The Broome County plants would be at the existing Binghamton-Johnson City and Endicott STP's. Chenango wastewater flow would be treated at the Binghamton-Johnson City STP. Tioga County plants would be the Town of Owego STP's No. 1 and 2, and the Owego Village STP.

In order to maintain a 5 mg/l minimum DO level in the Susquehanna River, secondary treatment plus nitrification would be applied to the Binghamton-Johnson City STP by the year 2018. Secondary treatment would be sufficient at the other three STP's.

Investigation of various infiltration control levels indicated the economically justifiable infiltration control level in the City of Binghamton was 3 mgd. Sewer rehabilitation to control infiltration was recommended by 1977.

Microscreening devices followed by chlorination facilities would be provided at the major overflow sites by 1980. A more detailed description of these facilities is included in Chapter V.

A detailed analysis of sludge management techniques is also summarized in Chapter V. It was recommended that land application for sludge be utilized.

The present worth of total costs (capital, operation, maintenance, and replacement) to the year 2020 would be $38.9 million, of which $25.1 million represented the local share.

Plan 8 - Secondary Treatment

The objective of this plan was to define a minimum cost wastewater management system that would maintain a minimum DO of 4 mg/l during both low flow periods and storm overflow conditions. Nonstructural measures for flow reduction were not included.

This plan included two STP's in Broome County and three STP's in Tioga County. The Broome County plants would be at the existing Binghamton-Johnson City and Endicott STP's. Chenango wastewater flow would be treated at Binghamton-Johnson City STP. Tioga County plants would be the Town of Owego STP's No. 1 and 2 and the Village of Owego STP.

Secondary treatment would be applied to all STP's. This would maintain a 4 mg/l minimum DO level in the Susquehanna River throughout the planning period.

Investigation of various infiltration control levels indicated the economically justifiable infiltration control level in the City of Binghamton was 1 mgd. Sewer rehabilitation to control infiltration was recommended by 1977.

Microscreening devices followed by chlorination facilities would be provided at the major overflow sites by 1980. A more detailed description of these facilities is included in Chapter V.

A detailed analysis of sludge management techniques is also summarized in Chapter V. It was recommended that land application of liquid sludge be utilized.

The present worth of total costs (capital, operation, maintenance, and replacement) would be $40.2 million, of which $2. million represented the local share.

Table VI-10 summarizes the major features of the 8 plans formulated and assessed in Stage III-1 planning.

IMPACT ASSESSMENT

The impacts associated with each of the 8 wastewater management plans were assessed for impacts in aquatic and terrestrial ecology, resource commitments, and social and economic factors. Each category denotes the short term impacts associated with construction, as well as the long term impacts associated with operation. A complete description can be found in the Impact Assessment and Evaluation Appendix.

All impacts were assessed for periods of low river flows (minimum average seven consecutive 7 day flow occuring once in 10 years - MA-7-CD-10), except those impacts particularly associated with combined sewer overflows. During design storm conditions, somewhat higher flows were assumed, i.e., 600 cfs in the Susquehanna River (as opposed to 330 cfs for MA-7-CD-10) and 200 cfs on the Chenango River. Assessment of each plan was made in comparison to the conditions of the Baseline Plan for the year 2020. A summary of this assessment is presented in Table VI-12 following this section.

Aquatic Ecology - Long Term

Major aquatic ecology impacts were dependent primarily on the level of sewage treatment being achieved. Only minor differences in aquatic ecology impacts were associated with the degree of regionalization and the amount of flow reduction.

TABLE VI-10

STAGE III-1 PLANS

Plan No.	Treatment Objective	Treatment Process	Regionalization (Broome & Tioga) STP's	Infiltration (Level of Reduction mgd)	Nonstructured (% Attained or Applied)[4]	Storm Water Treatment	Sludge Disposal Method	Dissolved Oxygen mg/l	Decision Component
1	1977 Baseline Conditions	Secondary	2+3	0.0	0	None	Existing Methods	3-4	Baseline
2	Water quality standards (5 mg/l DO)	Secondary & Nitr. at B-JC[1]	2+2	3.0	0	Micro-screen + Chlorination	Land Application	5-6	Degree of regionalization
3	"	"	3+3	3.0	0	"	"	5-6	"
4	Zero Discharge Goal	Bio-AWT[2]	2+2	3.0	100	"	"	6-7	Method of achieving zero discharge
5	"	P/C AWT[3]	2+2	5.0	100	"	"	6-7	"
6	Summer Zero Discharge	Sec. + Land Treatment	2+2	5.0	100	"	"	6-7	Land Treatment
7	Water quality standard (5 mg/l DO)	Sec. + Nitri. at B-JC[1]	2+3	3.0	100	"	"	5-6	Flow Reduction Measures
8	Water quality standard (4 mg/l DO)	Secondary	2+3	1.0	0	"	"	4-5	4.0 mg/l Dissolved Oxygen

[1] Secondary at all plants with nitrification added to Binghamton-Johnson City STP
[2] Biological based advanced waste treatment
[3] Physical/Chemical based advanced waste treatment
[4] 100% implies maintaining per capita flows at the current rate.

The minimum instream DO concentrations predicted for the Susquehanna River during low flow conditions by the year 2020 were as follows: 3. mg/l for the Baseline Plan; above 4 mg/l for secondary treatment (Plan 8); above 5 mg/l for improved secondary treatment (Plans 2, 3, and 7); and 6 to 7 mg/l for advanced waste treatment and land treatment (Plans 4, 5, and 6).

All plans, except the Baseline and possibly No. 8 (secondary treatment), would achieve the New York State standard for DO in both the Susquehanna and Chenango Rivers of a minimum daily average of 5.0 mg/l and not less than 4.0 mg/l at any time. As the DO concentration predicted by the model lies between the minimum and minimum daily average value, some uncertainty existed as to the impact of Plan No. 8 (4.4 mg/l). It was included in the event the less conservative interpretation is applied (i.e., if the model was assumed to predict the minimum DO level) then Plan No. 8 would achieve the standard.

Aquatic Ecology - Short Term

Temporary impacts to aquatic ecosystems would result during construction of interceptors and other pipelines across rivers and streams. Such crossings would temporarily increase sedimentation within surface waters and may thus create locally stressful conditions to aquatic flora and fauna. A measure of the extent of such temporary adverse impacts was the number of major stream crossings involved in any plan. In the Baseline Plan, only one such crossing would be required; in Plan 7, seasonal land treatment, seven crossings would be necessary for interceptors and transmission mains to the land application sites. The other plans would require two river crossings.

Terrestrial Ecology - Long Term

Interceptors.

By providing a community service such as sewering, the construction of interceptors may induce development in areas which are not presently serviced by existing wastewater treatment facilities. However, most of the development that may occur was also projected to occur under the

Baseline Plan. Therefore, any long term impacts for any plan would not be substantially different than what may be expected under the Baseline Plan.

Land Treatment.

A serious consideration with regard to large land application sites is whether or not to invoke eminent domain on existing residents. If all existing users are moved, by eminent domain, then design, construction, and operation of the system becomes simplified, in that very large contiguous blocks of land can be devoted to the land application system. In addition, the question of whether the system is a "good neighbor" becomes academic. However, invoking eminent domain, in itself, creates a socio-economic impact by displacing families. It was judged the latter impact would be more adverse than the impacts of parceling the land for land application. The system was designed therefore, by use of liberal buffer zones, to be as compatible as possible with existing land users.

Seasonal land treatment (Plan No. 7) would require about 5,700 acres in Broome County and 690 acres in Tioga County. Scrub and forest cover accounts for 75 percent of this land in Broome County and 50 percent in Tioga County. Agricultural lands, both active and inactive, comprise the remainder.

Spray irrigation of secondary effluent may have both beneficial and adverse impacts to the terrestrial ecosystem. Phosphorus and nitrogen contributions from the wastewater effluent may enrich nutrient deficient soils resulting in greater vegetative growth. However, too much nitrogen may result in undesirable nitrate levels in groundwaters. Proper design and strict monitoring could mitigate these potential problems.

Suspended solids and other organic matter present in treated waste effluent would add to the organic content of soils, thereby enriching those soils with low organic content. However, too great an application of wastewater may result in clogging of soil pore spaces creating odor and health problems.

Heavy metals present in the treated wastewater effluent may be accumulated by various plant species. Problems of heavy metals are, however, more serious when applying sewage sludges.

Obviously, the larger the area to which wastewater would be applied, the greater the possibilities of systems failure with possible severe adverse impacts to terrestrial ecosystems. In addition, a wide range of topographic, geologic, hydrologic, and edaphic factors would influence the success or failure of a spray irrigation system in the Broome-Tioga County area.

Land Application of Sludge.

Application of liquid sludge to agricultural lands in all action plans would require land for both the application and storage of the sludge. The land requirements varied depending on the level of wastewater treatment. Plans using secondary treatment, secondary plus nitrification treatment, and spray irrigation of effluent (Plans 2, 3, 6, 7, 8) would require 1,770 acres for the application of liquid sludge. The advanced waste treatment alternatives (Plans 4 and 5), since they produce more sludge, would require more land area. The biological advanced waste treatment alternative would require 2,765 acres for land application of liquid sludge. The physical/chemical advanced waste treatment alternative would utilize 2,825 acres for land application of the sludge.

Terrestrial Ecology - Short Term

Wastewater management construction impacts upon terrestrial ecology would be apparent during the construction of sewage treatment plants, interceptors, and other transmission pipelines. Direct adverse impacts would occur to terrestrial vegetation and associated wildlife habitats trees and shrubs would be uprooted and wildlife would either be killed or displaced. Installation of pipelines may also result in erosion. Construction of interceptors and effluent pipelines would directly affect terrestrial ecology when such pipelines are constructed through unbroken land. A measure of the extent of such direct adverse terrestrial impacts was the number of miles of pipeline to be constructed which do not follow existing roadways. Therefore, the higher the degree of regionalization, the greater the disruption.

The Baseline Plan would result in direct adverse impacts along four miles of regional interceptors. Other wastewater management plans would impact upon additional areas depending on the extent of regionalization and method of wastewater treatment.

For plans which regionalized the Chenango Valley with Binghamton-Johnson City an additional 4.3 miles of interceptors would be constructed in areas not following roadways compared to only 2.8 miles with separate treatment provided at Chenango Valley. For plans which regionalized Owego Village with West Owego, 0.9 mile of interceptor construction would not be along roadways.

Plan No. 8, land treatment of secondary wastewater effluent, would require construction of about 2 miles of effluent pipeline to the application site not following existing roadways (in addition to the 5.2 miles of regional interceptor).

Those plans which utilized a separate Chenango Valley treatment plant would need approximately 5 acres of a presently weedy vacant area adjacent to Route 11 near the Broome Community College. The vegetation and wildlife associated with these 5 acres is similar to recently abandoned farmland. Its utilization for a treatment plant site would not have major adverse impacts to the terrestrial ecology of the area.

Resource Commitments

Resources committed to wastewater management systems may be classified as either consumptive (irretrievable) or nonconsumptive (retrievable). Commitments of land acreage to a wastewater management scheme would be made for at least the life of the wastewater management project, but may be converted to other uses after the abandonment of the wastewater project. Land commitments are therefore nonconsumptive uses of local resources. On the other hand, resources such as chemicals, electricity, and fuel are consumed during wastewater treatment and disposal and, therefore, represent irretrievable commitments of resources.

Land Commitments.

The major land commitments associated with wastewater management were those acres devoted to physical facilities (e.g., treatment plants), spray irrigation of sewage effluent and land application of sludge.

Those plans which provided for separate treatment of wastewater in the Chenango Valley area would require a commitment of approximately 5 acres of flood plain land for a new STP.

Spray application of treated sewage effluent would require the temporary commitment, for at least the life of the project, of approximately 6,400 acres, most of which is in shrub and forest cover.

Land application of sewage sludge would require the commitment, for at least the life of the project, of about 1,800 to 2,800 acres of active agricultural land, depending on the treatment methodology used. Since lands required for application of sewage sludge were already used for agricultural activities, no unalterable commitments of land for sludge application would be made.

Electricity.

The electrical consumption of the wastewater management schemes is presented in Table VI-12.

The biological advanced waste treatment system would utilize 79 percent more electricity than the Baseline Plan. In terms of areawide consumption, this increased electrical consumption may be slightly adverse. The annual electrical consumption required for the Land Treatment Plan represents 1.9 percent of the yearly electrical consumption in the Urban Study Area and would utilize 170 percent more electricity than the Baseline Plan. On a yearly basis, the additional consumption of electricity by the spray application may represent only a slight adverse impact to areawide electrical consumption. However, of more significance was the proportion of the area's peak summer electrical demand for which the land treatment system would account. This proportion, 3.7 percent, of the peak summer demand may produce a significant adverse impact upon electrical resources when they are needed the most.

The remaining plans would not use significantly more electricity than the Baseline.

Chlorine.

Consumptive use of chlorine would take place in all wastewater plans including the Baseline.

The amount of total chlorine used for disinfection of STP effluents would depend on the level of prior treatment. Generally, a higher level of treatment prior to effluent disposal would require less chlorine for disinfection. In those systems emphasizing secondary treatment or secondary treatment with nitrification, the amount of chlorine utilized would not be significantly different than the amount of chlorine used under the Baseline Plan (about 270 tons/year).

Biological advanced waste treatment would utilize one-half of the chlorine required by the Baseline Plan. Since chlorine shortages have appeared at sewage treatment plants around the country in recent years, this reduction may represent a beneficial impact upon nationwide chlorine resources.

The physical/chemical advanced waste treatment system would utilize 14,000 tons/year of chlorine, primarily for the breakpoint chlorination process for nitrogen removal. Such a large commitment of chlorine may seriously impact upon available resources.

The amount of chlorine used for stormwater disinfection amounts to 3.7 tons per year, a small fraction of that required for treatment plant effluents.

Activated Carbon.

Activated carbon would be used for both biological and physical/chemical AWT systems. However, the physical/chemical system (Plan 5) would utilize significantly more carbon (830 vs. 121 tons/year) and may have a significant adverse impact depending on local availability.

Coagulants.

Coagulants such as alum and polymers would be required for phosphorus removal in both AWT plans. The consumptive use of these chemicals would be about the same for both Plans 4 and 5 and may adversely impact upon available resources.

Fuel.

The fuel consumed by the AWT systems would be significantly higher than the Baseline. In terms of areawide consumption, the biological based scheme would use 0.11 percent (160,000 gallons/year) compared to 0.64 percent

(950,000 gallons/year) for the physical/chemical system. Fuel consumption under the Baseline, secondary, and improved secondary plans would be about 14,000 gallons per year. The fuel required for the AWT systems, particularly for physical/chemical, may result in a significant impact if fuel again becomes a critical commodity.

Methanol.

The methanol required for the denitrification process in the biological based AWT system (Plan 7) may result in a significant adverse impact depending on local availability.

Lime.

No plan would use significantly more lime than that used for the Baseline.

Social Factors - Long Term

Growth and Development.

It was assumed projected population growth and development in the Study Area would occur whether or not sewerage services were provided. However, growth would tend to concentrate within and near areas which provide sewerage services.

Haphazard expansion of sewerage services which may occur under the Baseline Plan may or may not result in development patterns which were desired either on the local or regional level.

On a regional basis, development induced by any of the "action" plans would conform to desired development patterns as expressed in the General Plan for Broome and Tioga Counties (Egner and Niederkorn Assoc., Vol. 4, 1972). Regionalization of waste treatment facilities and land application of wastewater effluent have the greatest potentials to affect future local development patterns but no undesirable development is likely to occur as a result of either. However, implementation of the land treatment plan would reserve 38 percent (8.9 square miles) of the Town of Binghamton from future development. Committment of such a large part of the Town may have a severe impact on desired land use,

population growth, and economy of the community. The major portion of any population increase would have to be accommodated in either the northern or very southern portions of the Town.

Land application of liquid sludge proposed for all of the action plans would have no adverse impacts associated with conflicting land uses as the sludge would be applied only in areas designated for agricultural activities.

Public Health.

The elimination of septic system failures and overflows into area waterways would be a beneficial impact achieved by all plans in comparison to the Baseline Plan. Furthermore, the treatment of combined sewer overflows would represent another beneficial impact to public health in comparison to the Baseline Plan.

Chlorination of secondary effluent prior to land application should result in substantial reduction of pathogenic micro-organisms within the soil. However, aerosol dispersion of pathogens, particularly viruses, may occur during the spraying operation. Mitigating measures such as sufficient buffer zones around spray application areas can minimize these possible adverse impacts. If application rates of sewage effluent are too high, ponding and surface runoff may also transmit disease micro-organisms.

Recreation.

Some improvements to potentials for secondary water contact recreation, particularly fishing may result from those plans which provided for high dissolved oxygen, low ammonia and chlorine, and low nutrient concentrations within the area's waterways in comparison to the Baseline Plan.

Significant reductions in total and fecal coliform, especially as a result of treatment of combined sewer overflows, would improve the potentials for primary water contact recreation in all action plans as compared to the Baseline Plan.

It should be kept in mind that although a wastewater management plan may improve the potentials for water contact recreation, no plan would result in significant increases in participation of water-related activities unless the other problems, such as access, which presently restrict water recreation, are also provided.

Aesthetics.

Wastewater management facilities including sewage treatment plants, spray irrigation sites, and storm overflow management facilities may produce dust, noise, and odors during operation of the facilities and may be visually unaesthetic.

Dust and noise produced during operation of sewage treatment plants is usually minimal, although odors may become a problem particularly if a plant is overloaded or if it is not operated properly. Odors, therefore, may be particularly offensive under the Baseline Plan since by the year 2020, all sewage treatment plants would be overloaded. Assuming proper operation and maintenance, sewage treatment plants in the other plans should create no offensive odor problems. Stormwater overflow management facilities would create only negligible dust, noise, and odor problems. Spray irrigation of sewage effluent may create serious odor and health problems if soils become clogged, producing ponding and surface runoff.

Odors eminating from the sludge lagoons, in all of the action plans, may be particularly offensive to nearby residents during the six months of winter storage. Storage of sludge from physical/chemical processes (Plans 4 and 5) would create greater odor problems than sludges produced in other systems as physical/chemical sludges would not be digested prior to storage.

Social Factors - Short Term

Recreation.

Parks and other recreational places may be temporarily disturbed during construction of various wastewater management facilities. With the subregionalization plans, construction of the Chenango Valley STP, in particular its outfall to the Chenango River, would temporarily disturb recreational activities within the Route 81 River Park. This park would also be temporarily disrupted, however, with the construction of an interceptor from the Chenango Valley area to the Binghamton-Johnson City sewer system.

The land application plan would require the construction of pipelines to the various spray irrigation sites. During construction of these pipelines, the major recreational facility

which would be temporarily disturbed would be Hickories Park in the Town of Owego.

Aesthetics.

The creation of dust, noise, and traffic disruption would be created near construction activities. The greater the length of sewer construction activities along roadways, the more adverse the disturbance. In general, plans which regionalized service areas would result in 1 or 2 miles of interceptor construction along roadways above that required for subregionalization. The land treatment plans would require an additional 12 miles of effluent pipeline to be constructed along roadways.

Historical, Cultural, and Archaeological Sites.

No national historic sites would be impacted during either construction or operation of any wastewater management facility. Locally important historic and cultural sites in the Village of Owego, particularly on Front Street would be temporarily impacted, via dust and noise, during the construction of an interceptor between the Owego Village STP and the West Owego STP (Owego STP #1).

Construction of wastewater management facilities including sewage treatment plants, interceptors, transmission pipelines, and stormwater treatment facilities would involve extensive digging within the Susquehanna and Chenango River valleys and may thus, disturb important archaeological sites. Since, however, the exact location of archaeological sites within the river valleys was unknown in Stage III-1, the extent of any adverse impacts upon archaeological resources was uncertain. A Cultural Resources Reconnaissance was performed concurrently with the work in Stage III-1, and the results are incorporated in Stage III-2.

Economic Factors

The capital, O&M, and replacement costs, expressed as present worth, are presented in Table VI-11. These costs represent sewage collection, treatment, sludge disposal, and replacement costs. Costs for stormwater management, infiltration control, and nonstructural measures were not developed in this iteration. Next to the Baseline Plan, the

TABLE VI-11

TOTAL COSTS -- STAGE III-1 PLANS[1]

Plan	Treatment	Regionalization (Broome & Tioga STP's)	Present Worth ($ Million)[2] Capital	O&M	Replacement	Total
1	Baseline	2 + 3	2.5	19.7	10.4	32.6
2	Sec. + Nitr. @ B-JC	2 + 2	11.3	21.9	11.1	44.3
3	Sec. + Nitr. @ B-JC	3 + 3	11.2	23.0	11.6	45.8
4	Bio AWT	2 + 2	21.1	47.3	13.5	81.9
5	P/C AWT	2 + 2	18.4	59.6	6.3	84.3
6	Sec. + Seasonal Land Treatment	2 + 2	25.8	29.8	13.8	69.4
7	Sec. + Nitr. @ B-JC + Nonstructural	2 + 3	8.1	20.4	10.4	38.9
8	Secondary	2 + 3	8.8	21.0	10.4	40.2

1 Does not include costs for infiltration control, nonstructural measures, and stormwater management.

2 Based on 5 7/8 percent and 50 years.

least cost system was Plan 7, opting for maximum flow reduction and minimum levels of treatment to maintain the DO above 5 mg/l. Costs for infiltration control and non-structural measures were not included in this iteration, however. Plan 8, secondary treatment, was only slightly more costly and does not rely significantly on the effectiveness of flow reduction measures to reduce cost. Plans 2 and 3 which would achieve a minimum of 5 mg/l DO, are not significantly different in cost. Plan 2 which regionalizes Owego Village with West Owego and Chenango Valley with Binghamton-Johnson City, would be slightly less expensive than Plan 3 which provides a separate treatment plant for each service area. Plans 4 and 5, advanced waste treatment, are also not significantly different in cost. Although the total cost of the physical/chemical system is slightly less than biological AWT, the yearly O&M for this plan (No. 5) would be somewhat higher than Plan 4. Costs for Plan 6, although lower than either AWT system (operated year-round), were not directly comparable due to the seasonal nature of this system (April--September).

The annual local residential costs per capita within each service area are presented in Table VI-12. The cost figures in the Summary Table assume:

a. Construction - 75% Federal, 12 1/2% State, 12 1/2% local.

b. Operation and Maintenance - 33% State, 67% Local.

c. O% Inflation.

d. 0% Income Rise.

e. 5 7/8% bond rate and 50-year economic life.

Per capita annual costs for any system varied depending on the service area and level of treatment achieved. In the Chenango Valley area, the least annual per capita costs (of an action plan) occurred under Plan 8 which provided just secondary treatment. The least cost system for the Binghamton-Johnson City service area was also No. 8. However, the costs of Plan No. 7 (nonstructural) were not significantly higher.

The least cost system on a per capita basis for the Endicott service area was Plan No. 7, which emphasized nonstructural methods for waste flow reduction. However, the Baseline Plan was not significantly greater in cost.

TABLE IV-7

IMPACT ASSESSMENT SUMMARY STAGE III-1

(YEAR 2020)

IMPACT INDICATORS ECOLOGICAL	1 BASELINE PLAN	2 FOUR PLANTS 2 BROOME SUM	2 TIOGA	3 SIX PLANTS 3BROOME SUM	3TIOGA	4 BIOLOGICAL AWT	5 PHYSICAL/CHEMICAL AWT	6 SEASONAL LAND APPLICATION	7 NON-STRUCTURAL + I-CONTROL	8 SECONDARY TREATMENT
1. # Major Stream Crossings	1	2		2		2	2	7	2	2
2. DO (mg/1)										
a) MA-7-CD$_{10}$	3.5	5.4		5.5		6.7	6.7	6.9	5.1	4.4
b) Design Storm	3-4	5-6		5-6		5-6	5-6	5-6	5-6	4-5
3. Total N lb/day	6830	7540		7540		625	625	0	7540	7540
4. Total P lb/day	1740	1905		1905		155	155	0	1905	1905
5. NH_3 (mg/1)	2.06	1.14		1.12		0.18	0.18	0	1.67	2.02
6. Benefit to Fisheries Resources	None	Moderate		Moderate		Large	Large	Large	Moderate	Slight
7. Maximum Total Coliform (MPN/100 ml)										
a) MA-7-CD$_{10}$	<1000	360		340		360	360	0	360	360
b) Design Storm	240,000	1040		1025		1040	1040	<1000	1040	1040
8. Acreage for new STP	0	0		5		0	0	0	0	0
9. Acreage for Spray Irrigation of effluent	0	0		0		0	0	6400	0	0
10. Acreage for Land Application of sludge	-	1770 (7.0 for storage)		1770 (7.0 for storage)		2765 (16.0 for storage)	2825 (16.0 for storage)	1770 (7.0 for storage)	1770 (7.0 for storage)	1770 (7.0 for storage)
11. Miles of Regional Interceptors not Along Existing Roadways	4.0	4.3	.9	2.8		5.2	5.2	5.2	4.3	4.3
12. Miles of Other Pipeline not Along Existing Roadways	0	0		0		0	0	2.0	0	0
RESOURCE COMMITMENTS										
1. Total Lane Requirements (acres)	-	1777		1777		2781	2841	8177	1777	1777
2. Electricity (KWHr/Yr)	$11.2x10^6$	$16x10^6$		$16x10^6$		$20x10^6$	$10x10^6$	$30.5x10^6$	$11.5x10^6$	$11.5x10^6$
3. Chlorine (tons/Yr)	271	267		267		147	14,000	282	282	282
4. Lime (tons/year)	798-1198	840-1261		840-1261		1383-2074	1413-2119	840-1261	840-1261	840-1261
5. Activated Carbon (tons/Yr)	-	-		-		121	830	-	-	-
6. Methanol (tons/yr)	-	-		-		3570	-	-	-	-
7. Coagulants										
a) Alum (tons/yr)	-	-		-		10,400	10,400	-	-	-
b) Polymers (tons/yr)	-	-		-		65	65	-	-	-
8. Fuel (gal/yr)	13,900	14,700		14,700		158,700	951,000	14,700	14,700	14,700
SOCIAL										
1. Miles of regional interceptors along existing roadways	4.5	2.3	0.9	1.4		3.2	3.2	3.2	2.3	2.3
2. Miles of other pipelines along existing roadways	0	0		0		0	0	12.1	0	0
3. # historic sites disturbed	0	0		0		0	0	0	0	0
4. # recreational places disturbed	0	2		2		2	2	4	2	2
5. Improvement to Secondary Water Contact Recreation Potentials	None	Moderate		Moderate		Large	Large	Large	Moderate	Slight
6. Improvement to Primary Water Contact Recreation Potentials	None	Large		Large		Large	Large	Large	Large	Large
7. # Families Displaced	0	0		0		0	0	0	0	0
8. Result in locally desired development patterns	May or May not	Yes		Yes		Yes	Yes	No	Yes	Yes
9. Result in regionally desired development patterns	May or May not	Yes		Yes		Yes	Yes	Yes	Yes	Yes
10. Contravene air quality standards	No	No		No		No	No	No	No	No
ECONOMIC										
Annual per capita costs ($)										
1. Chenango Valley - Service Area	-	3.92		5.64		8.01	9.15	5.45	3.49	3.39
2. B-JC Service Area	3.65	3.92		4.13		8.01	9.15	5.45	3.49	3.39
3. Endicott Service Area	4.24	4.73		4.73		9.21	10.94	5.70	4.18	4.73
4. E. Owego Service Area	5.77	6.51		6.51		13.45	12.31	6.49	6.51	6.51
5. W. Owego Service Area	3.25		5.07		4.29	15.27	14.58	6.33	4.29	4.29
6. Owego Village Service Area	7.48		5.07		6.73	15.27	14.58	6.33	6.73	6.73

In both the East and West Owego service areas, the least annual per capita costs were associated with the Baseline Plan. For the Owego Village service area, the least annual per capita costs were associated with Plan No. 2, which provided for a regionalized secondary treatment facility for a combined Owego Village - West Owego Service area.

Annual per capita costs were also dependent on the degree of regionalization. In the Chenango Valley area, regionalization (with the Binghamton-Johnson City plant) was generally less expensive per capita than subregionalization (separate treatment plant). Likewise, for the Binghamton-Johnson City service area resident, regionalization was less expensive. In the West Owego and Owego Village service area, separate treatment plants for West Owego and Owego Village were less expensive.

Physical/chemical advanced waste treatment was the most costly scheme for the Chenango Valley, Binghamton-Johnson City, and Endicott service areas; whereas biological advanced waste treatment was slightly more costly than P/C AWT for the East Owego, West Owego, and Owego Village service areas on an annual per capita basis.

SELECTION OF PLANS FOR FURTHER STUDY

The previous sections presented the economic, environmental, and social impacts of the 8 wastewater management plans. The purpose of this section is to examine the tradeoffs among plans and select the most desirable for final plan development. The following decision components were analyzed to screen the plans:

a. Broome County Regionalization

b. Tioga County Regionalization

c. Advanced Waste Treatment System

d. Land Treatment

e. Flow Reduction Plan

f. 4.0 mg/l DO Plan

Broome County Regionalization

The question was whether to treat the wastewater from the Chenango Valley at the Bingamton-Johnson City STP, or at a separate, new facility. This question was to be resolved by an evaluation of Plans 2 and 3, where the objectives was to achieve 5.0 mg/l DO at least cost.

The impacts associated with the degree of regionalization in Broome County can be compared by evaluating the similarities and differences of Plans 2 and 3 in the Impact Assessment Summary for Stage III-1, Table VI-12. Both plans provided for secondary treatment facilities at all STP's with the addition of nitrification at the Binghamton-Johnson City STP. In Plan 2, Chenango Valley and Binghamton-Johnson City were regionalized and in Plan 3 they are not, with a separate facility being constructed for Chenango Valley.

The aquatic ecology impacts associated with regionalization were not significantly different from those associated with subregionalization. The number of major stream crossings (i.e., the amount of temporary adverse impacts) in both schemes was the same.

The DO concentration during low flows and the total maximum coliform concentration were slightly, but not significantly, more beneficial in the subregionalization scheme.

The adverse terrestrial ecology impacts associated with the requirement of a new STP in the subregionalization scheme was counterbalanced by the additional miles of connecting interceptors required for the regionalization scheme. Therefore, neither regionalization scheme was significantly more beneficial than the other in terms of terrestrial ecology impacts.

Under the social impact category, the number and location of recreational facilities (i.e., ball park in the Town of Chenango, and the Route 81 River Park) disturbed during construction were the same. However, a separate STP for Chenango Valley may disturb the Route 81 River Park users on a long-term basis via odors and other unfavorable aesthetic implications of treatment plants. Temporary dust and noise impacts associated with interceptor construction along existing roadways were greater for the regionalization scheme.

Therefore, on a cumulative basis, the additional short-term impact associated with regionalization may be offset by the possible additional long-term impacts of subregionalization.

The most significant differences between regionalization and subregionalization in Broome County were the economic factors. The economic impacts to both the Chenango Valley and Binghamton-Johnson City service areas were less under regionalization. However, there was an institutional drawback to regionalization in the present cost sharing formula which Binghamton-Johnson City requires of outlying area connectors. Under this formula, it would be more economical for Chenango Valley to build its own plant than to connect to Binghamton-Johnson City. Modification to the existing institutions could take the form either of changing the cost sharing formula or the establishment of a completely new institution with jurisdiction over both service areas. Such an arrangement would have other advantages as well, as discussed in the Institutional Analyses Appendix.

The issue of regionalization was further complicated by the uncertainty of Binghamton's Northside Interceptor to handle the additional flows from Chenango Valley. An inflow/infiltration analysis measured infiltration of about 2 mgd in this interceptor (Shumaker, 1974). Adequate capacity for Chenango Valley sewage should be available provided this infiltration can be eliminated. The City of Binghamton will be conducting a sewer evaluation study to formulate correctional measures.

If this excess flow is not reduced, however, then a new interceptor from Chenango Valley all the way to the Binghamton-Johnson City STP may be required. If sufficient capacity can be made available in the existing interceptor, then only a shorter pipe from Chenango Valley to the north end of the Binghamton-Johnson City interceptor would be needed.

A recent study compared the costs of a separate Chenango Valley plant versus a long interceptor to the Binghamton-Johnson City STP (Martin, 1975). Construction of a new plant was found to have substantially lower costs than for regionalization, assuming a long interceptor would be required.

For the Binghamton Wastewater Management Study, a short interceptor connecting to the northern part of the Binghamton sewerage system was used. Storage facilities and a pumping station were also included to retain flows from Chenango Valley during storm conditions, thereby preventing any

increase in overflows from the Binghamton sewer system. With this shorter interceptor, regionalization was determined to be the cost-expective approach for all levels of treatment. Likewise, subregionalization was favored for all systems utilizing the long interceptor.

Previously, it was assumed that if the Chenango Valley STP were to be constructed, a long outfall pipe would be built to discharge the plant's effluent downstream of the Route 81 River Park. However, the park was not designed for primary contact recreation in the Chenango River. For this reason, and because a short outfall discharging upstream of the park would be less expensive ($700,000 reduction in present worth), the shorter pipe may be the only option which would be eligible for funding. The short outfall also reduced the cost advantage of regionalization over providing separate treatment.

In summary, the regionalization scheme (two STP's in Broome County) was the cost-effective solution but would require a greater modification of the present institutional arrangements than the subregionalization scheme (three STP's). Also, the ability of the Binghamton system to handle flows from Chenango Valley may depend upon the elimination of existing infiltration in a major interceptor. Environmental impacts and resource committments were about equal for both systems.

The Technical Advisory Committee considered an interim plant as one possible solution to the complex question confronting Binghamton-Johnson City and Chenango Valley. An interim plant would provide the opportunity to meet immediate needs, to form a new sewer district, and to observe the results of the sewer evaluation study and correctional action in the Binghamton-Johnson City sewer system.

The Interagency Study Management Group recommended that plans achieving either 4 or 5 mgl DO consider all three schemes for final plan analysis: regionalization, subregionalization, and an interim plan at Chenango Valley to help determine the best long range system.

For plans achieving advance waste treatment levels, only the regionalization scheme was considered further, as it was clearly the cost-effective approach.

Tioga County Regionalization

This question of the optimum number of STP's for Tioga County was resolved based on analysis of Plans 2 and 3. The decision to be made was whether to treat Owego Village's waste separately or at the West Owego STP. An analysis was also made for treating West Owego's wastewater at Owego Village. Common to both schemes was the attainment of 5 mgl DO in the Susquehanna River due to the addition of nitrification at the Binghamton-Johnson City STP.

The subregionalization scheme providing for separate treatment plants at Owego Village and West Owego was the cost-effective solution at the secondary treatment level, and its environmental impacts, resource commitments, and socio-economic impacts were no more severe than those for regionalization.

The subregionalization scheme would require no modifications to existing institutions, whereas minor modifications would be required for either regionalization scheme. Since the subregionalization scheme was cost effective, and involved no disadvantages in comparison to regionalization, it was concluded that Owego Village and West Owego should treat their wastes separately, at the secondary or improved secondary treatment level. For higher degrees of treatment (AWT and land treatment) the economics of scale favored treatment of Owego Village wastewater at West Owego.

Advanced Waste Treatment Systems

Plans 4 and 5 provided the opportunity to assess and evaluate two methods for Advanced Waste Treatment, biological and physical/chemical. Cost-effectiveness analyses, as described earlier in this chapter, favored two plants in Broome County and two in Tioga, with 100 percent attainment of non-structural flow reduction. The cost effective levels of infiltration control at Binghamton-Johnson City were 3.0 mgd for Bio. AWT and 5.0 mgd for P/C AWT.

On an overall basis, i.e., the entire study area, the biological process was more cost effective, equal to P/C in environmental impact, and institutional arrangements, and would have a smaller commitment of resources. In addition, it provided much greater flexibility than P/C in that it involved a sequence of more treatment steps, each with a specific effluent objective:

a. Secondary

b. Nitrification for higher removals of oxygen demand

c. Denitrification plus coagulation for nutrient removal

d. Filtration and activated carbon for final polishing.

The P/C system, on the other hand, used unit processes which overlap in their purposes, e.g., coagulation for nutrient and BOD removal, and use of activated carbon for reduction of BOD from greater than the secondary treatment level to the zero discharge level.

One of the flexibilities that should be designed into a treatment system is that of responding incrementally to greater levels of water quality requirements over time, i.e., the flexibility to stage construction. This conclusion was based on the likelihood that, although PL 92-500 established a goal of zero discharge by 1985, in actual fact this goal probably will be reached much later in time, and in incremental stages.

Support of this is taken from the 1975 Water Strategy Paper of EPA, which stated that achievement of the 1985 goal, in some cases, may be neither cost-effective nor environmentally sound.

The biological system would achieve this flexibility, whereas the P/C system would not. For example, for the P/C system to provide a removal of oxygen demand equal to that obtainable with activated sludge plus biological nitrification, all the P/C treatment units - coagulation, settling, breakpoint chlorination, filtration, and activated carbon - would have to be employed. This lack of flexibility would be a drawback of the physical/chemical system.

In the Endicott and East Owego service areas, the biological system was slightly poorer in cost-effectiveness than the P/C system. In addition, in East and West Owego, it was slightly greater in socio-economic impact than the P/C. These slight disadvantages in cost factors for the biological system, in some of the service areas, would be more than overcome by the advantages the system exhibits in flexibility and in resource consumption.

In addition, there were two other factors which tended to favor the biological system:

1. The P/C system was higher in O&M but lower in capital than the biological system; thus, the biological system gained in cost effectiveness and socio-economic impact (lower cost per capita) when inflation was included in the analysis. Since inflation can be expected to take place, the impact of the biological system would be mitigated.

2. The major O&M cost in the P/C system was for chemicals, whereas the O&M in the biological system was more labor intensive. Thus, the O&M dollar for the P/C system would leave the study area, whereas the biological O&M dollar would be spent more on a local resource, i.e., the operating personnel.

In light of the above, it was concluded that the biological system exhibited an overall advantage compared to the physical/chemical system, and that the physical/chemical system should be eliminated from further consideration.

Land Treatment

The land treatment alternative was not comparable to any other system in its objective; therfore, it was not as amenable to a comparative analysis as were the regionalization and AWT systems. In its impact on water quality, it was poorer than the AWT systems, but better than the secondary (plus nitrification at Binghamton-Johnson City) treatment systems. Its costs, on a present worth basis, were also between the secondary treatment and AWT systems.

On an overall basis, considering the aspects of aquatic and terrestrial ecology, commitment of resources, social factors and economic impact, land application was rated the poorest of the treatment levels, primarily because of the extremely high impact on the study area land resource, electricty consumption, and aesthetics, with no strong compensating merits or beneficial impacts.

The most beneficial impact of this plan was the resulting high receiving water quality during the summer months. Similar effectiveness at the same cost could be achieved by operating the AWT portions of the biological AWT system only half the year (summer) and the secondary portion during the winter. Thus, the Bio-AWT system can be made as cost effective as the land application system, without the extreme resource commitment associated with the land application system.

On an institutional basis, the land application system was judged to require the greatest modification from the existing institutions. In Broome County, an agency at the County level, with the power of eminent domain, would be needed as town boundaries would be crossed. In Tioga County, implementation would be simpler since the system would be contained within the Town of Owego boundaries, and the implementation agency is already at the Town level.

It was concluded that the land application plan did not offer beneficial impacts sufficient to justify the large expenditures of money and the commitment of land resource necessary for implementation. It should be noted this conclusion was more strongly indicated for Broome County than for Tioga, where the costs and resource commitment were not as great as in Broome County. However, the benefits in Tioga were not as significant either. The Technical Advisory Committee also believed sufficient data was not available on the dependability and effectiveness of long-term operation of large land treatment systems in a climate, terrain, and soils such as exists in the Bicounty Area. In Tioga as well as in Broome, the adverse impacts of the land application system more than outweighed the beneficial ones, and therefore, this system was not selected for final plan development.

Flow Reduction Plan

The initial estimates of the effectiveness of nonstructural measures were rather arbitrary but for this iteration, a detailed analysis was performed. Effectiveness was measured as the percentage achieved in attaining the nonstructural aim; namely, maintaining the present per capita flows throughout the planning period (2020). The measures which were concluded to be most feasible were:

a. A pricing system to recover the costs of treatment via a metered rate.

b. An education program which would point out to the individual consumer the personal savings obtainable by installing water saving devices in the home.

Metering of water supplies is often considered to be the most effective means in reducing water consumption. The advanced waste treatment plan, if financed by metered rates, would result in very high composite rates for water and sewage treatment. Under such conditions, water users

would likely reduce their consumption to such a degree that the nonstructural plan would be almost automatically achieved. For less expensive treatment alternatives, the metered rate would be less, and therefore, the per capita consumption would be higher.

Therefore, a special education program was designed to point out to the consumer the personal advantages if he installed water-saving devices. The program was designed for the homeowner. For example, 20 year periods of analysis were not used; rather about 4 years was used as the time necessary to recover invested costs for plumbing resulting from water, sewer, and heating bill savings. Additionally, the program considered the various sewage rates which would result from different treatment levels. Thus, for each treatment level, the maximum degree of flow reduction was measured considering pricing and an education program. At secondary and nitrification treatment levels, the cost-effective flow reduction was rather low. At advanced treatment levels, the nonstructural objective of maintaining per capita flows at their present levels was almost always reached.

The analysis, summarized above and detailed in the Specialty Appendix, showed that people and industries would find their own equilibrium with regard to prices and demand. To force industries to use less water than they are willing to pay for would result in quantifiable economic impacts. Additionally, there are costs to domestic users (such as installing water saving devices), which can also be quantified in monetary terms. This continued flow reduction must also be accompanied by a major public information program.

The rationale behind the Flow Reduction Plan (No. 7) was that direct expenditures could be saved at the treatment plant. The costs to individuals and families of forcing reductions beyond what people would normally choose by their own economic decisions, were more than double those treatment savings, however. Therefore, to achieve the objective of Plan No. 7, flows must be reduced well beyond their cost-effective level in order to maintain current per capita flows.

The management committees recommended a total Nonstructural Plan not be carried into final plan analysis. It was felt the estimated flow reduction may be hard to achieve and even harder to maintain. The public education program for gasoline conservation in the spring of 1974 was mentioned as an example of temporary decrease in demand followed by a general increase. Although the committees decided to

drop the separate plan for flow reduction, the members further recommended a certain level on nonstructural attainment be set as a goal for the other plans. The advanced waste treatment scheme was the most appropriate one to be considered for full achievement of flow reduction. Therefore, Plan No. 7, the flow reduction scheme plus nitrification at Binghamton-Johnson City, was not considered further. For further information on nonstructural measures, the reader is referred to the Specialty Appendix.

4.0 mg/l DO Plan

The 4.0 mg/l DO plan (No. 8) had the advantage of being the one system to which the local institutions had generally been committed prior to this Study. This plan has the least direct economic cost and would produce a minimum of secondary treatment of all sewage effluent.

Secondary treatment would maintain DO levels above 4.0 mg/l during critical flow conditions as predicted by the water quality model for the Susquehanna River. However, as a strict interpretation, the predicted DO represented neither the minimum daily average (Standard of 5 mg/l) nor the minimum value (Standard of 4 mg/l) but represented a value in between. Whether secondary treatment would be sufficient to meet standards, therefore, depended on the interpretation of the model. The committees' recommendation was that the 4.0 mg/l plan be considered for final refinement because this was the least cost plan with ability to meet secondary effluent requirements.

SUMMARY OF RECOMMENDED PLANS FOR STAGE III-2

The following were the major principles for establishing the proposed plans, based on the overall criteria for water resources planning and on the concerns of the Interagency Study Management Group, Citizens Advisory Committee, and Technical Advisory Committee:

1. A least cost plan to meet water quality standards should be included for final consideration.

2. Plans with a predicted minimum DO concentration of either 4.0 mg/l or 5.0 mg/l can presently be considered to satisfy principle 1.

3. Both five and six plant regionalization systems should be considered for plans attaining either 4 or 5 mg/l DO. An interim plant for Chenango Valley should also be analyzed.

4. A system meeting or approaching the 1985 zero discharge goal should be considered.

5. Flow reduction nonstructural means and/or infiltration control should be considered for each plan.

Based on the above principles, further discussion led to the following conclusions.

To maintain 4 mg/l or 5 mg/l DO in the Susquehanna River at least cost, the most cost-effective regionalization employed the five existing sewage treatment plants of Binghamton-Johnson City and Endicott in Broome County and Town of Owego STP's 1 and 2 and Owego Village in Tioga County. However, from an institutional and political viewpoint, it may be more desirable for Chenango Valley to construct its own treatment plant. Therefore, a six plant regionalization system including a separate Chenango Valley facility was carried forward in the final plan analysis.

Biological based advanced waste treatment was more cost-effective and was more desirable from the standpoint of resource commitments and degree of flexibility than physical-chemical AWT. The optimal degree of regionlization at this level of treatment was two plants in Broome County (Binghamton-Johnson City and Endicott) and two plants in Tioga County (Town of Owego STP's 1 and 2).

Land treatment of secondary treated effluent was undesirable due to the large commitment of land. The beneficial impact of the land application plan on the Susquehanna can be exceeded by Bio AWT with a much less adverse impact. There was no compelling factor dictating further consideration of land application.

The optimal degree for nonstructural attainment is that which is cost-effective to the individual consumer; this level can be attained by pricing and a low level education program. Attainment of greater nonstructural control than the cost-effective level results in social costs greater than the monetary savings in operating sewage works.

The above principles and discussions were integrated to formulate the recommended plans for final development and evaluation. Four plans were carried forward:

1. The Baseline Plan.

2. A plan to meet 4.0 mg/l DO at least cost; both 5 and 6 plant regionalization systems would be considered. An interim plan for Chenango Valley would also be analyzed.

3. A plan to meet 5.0 mg/l DO at least cost; both 5 and 6 plant regionalization systems would be considered. An interim plan for Chenango Valley would also be analyzed.

4. A biological based AWT plan to approach the Corps of Engineers' definition of zero discharge (4 plant regionalization).

In formulating the specific characteristics of these plans, the following additional components would be applied to all but the Baseline Plan: infiltration control will be included in each plan, at the cost-effective level; nonstructural flow reduction would be considered in all plans and would be at the level found to be cost-effective for each level of treatment and for each service area; the most efficient sludge management scheme for all plans was the application of liquid sludge to agricultural land, plus a monitoring program; stormwater management in both Binghamton and Owego would be by microscreening and chlorination of combined sewer overflows.

STAGE III-1 PUBLIC INVOLVEMENT

The Stage III, Iteration 1 report (June 1975) refined the alternatives from Stage II into integrated wastewater management systems, i.e., each plan contained provisions for wastewater treatment and collection, stormwater control measures and sludge management.

In discussing the report, the Citizens Advisory Committee (CAC) stressed the importance of the institutional analysis and they felt more refinement was needed. This refinement was provided in the next iteration.

Nonstructural measures evoked considerable discussion. The CAC requested an analysis of flow reduction devices such as water saving toilets and showers. The consultant agreed to provide this information.

The CAC agreed to drop land treatment of wastewater due to the high cost and few compensating advantages in comparison to the advanced waste treatment (AWT) systems. Based on resource committments, the biological based AWT system was preferred to the physical/chemical plan.

The Technical Advisory Committee (TAC) also favored biological AWT to either the physical/chemical system or land treatment. A total nonstructural plan providing a minimum of treatment was not recommended for further analysis. Rather, the TAC believed a cost-effective level of nonstructural flow reduction should be applied to each plan.

Both the TAC and CAC agreed that a least cost plan achieving 4 mg/l DO and one achieving 5 mg/l be kept for final analysis. The degree of Broome County regionalization to be applied was uncertain, however.

The Interagency Study Management Group (ISMG), as well as the CAC and TAC, spent considerable time on the issue of where to treat Chenango Valley wastewater. The report prepared for the Broome County Legislature (Martin, 1975) recommended a sewage treatment plant be constructed in Chenango Valley, while the Corps' document favored an interceptor from Chenango Valley to the Binghamton-Johnson City plant. The differences in the assumptions, primarily in the capacity of the Binghamton-Johnson City system, of the two reports were discussed. Further analysis of the two studies was recommended as a clear concensus could not be reached. The New York State Department of Environmental Conservation also asked that a short outfall from the proposed Chenango Valley STP be investigated.

The ISMG concurred with a TAC suggestion that a phased plant for Chenango Valley be examined. It was believed, at this time, a phased plant would meet the immediate sewering needs while providing more time to assess the optimal degree of regionalization.

The ISMG also agreed with the TAC recommendation that land application of liquid sludge be included in every plan. Sludge disposal at landfills was selected as a backup should the former method prove unfeasible.

For plans achieving the minimum DO levels of 4 mg/l and 5 mg/l, the ISMG directed the final analysis to include: regionalization of Chenango Valley, subregionalization, and subregionalization with an interim plant in Chenango Valley.

Biological based AWT was selected as the best approach to achieve zero discharge.

STAGE III-ITERATION 2 - FINAL PLANS

The plans developed in the first iteration of Stage III comprised complete technical systems. With the exception of further investigation of regionalization for Broome County, only minor modifications were made in the technological analysis. To provide for the implementation and management of these systems, various institutional arrangements were analyzed and screened for each plan. From this final iteration of formulation, impact assessment and evaluation, four "Plans for Choice" are presented in Chapter VII.

BROOME COUNTY REGIONALIZATION

Based on the assumptions in Stage III - 1, regionalization of Chenango Valley's wastewater in the Binghamton-Johnson City system was found to be cost-effective. The incremental difference in present worth was 40 percent higher for subregionalizition than for regionalization.

However, two changes in system design were made in the final plan analysis which greatly reduced the difference in cost. In the subregional system, a short outfall built directly to the river was selected for the Chenango Valley STP in place of a long outfall routed downstream of the adjacent River Park. The long outfall was dropped from consideration as the Route 81 River Park was not designed for water contact recreation and, because it was not cost-effective, may not be eligible for State or Federal funding. By constructing the short, direct outfall, a savings of $700,000 in present worth would be realized.

The second change was made in the amount of aerated storage at the Chenango Valley pump station required for the regionalization system. The amount of storage was increased to better facilitate retention of Chenango Valley wastewater during storm periods, thereby preventing an increase in overflows from the City of Binghamton sewer system. The cost for storage, therefore, was necessarily increased by an additional $700,000.

Thus, these changes considerably reduced the cost difference between the two schemes, with regionalization only slightly more cost-effective than subregionalization.

The Interagency Study Management Group (ISMG) also felt there were still some unresolved or undocumented issues with respect to the Chenango Valley question and recommended that both regionalization and subregionalization systems be considered in the final plan analysis. The major unanswered questions evolved around two pertinent aspects:

1. How great is the need of sewering in Chenango Valley?

2. Is there any difference in implementation time between regionalization and subregionalization?

The ISMG observed that if the need for sewering were great, then the time for implementation would be an important factor in deciding which schemes were the more desirable.

In addition to the above questions, there were several factors favoring a subregionalization scheme: under the present cost-sharing agreements between Binghamton-Johnson City and outlying communities, Chenango Valley residents would actually pay more for regionalization than subregionalization (even though the total present worth of regionalization would be less). Additionally, regionalization would aggravate existing problems of storm water overflows and infiltraton in the city sewer system and the limited expansion capabilities of the Binghamton-Johnson City STP.

Considering these factors, the ISMG recommended that, in addition to the continued analysis of the two regionalization systems, an "Interim Plan" for subregionalization be formulated and evaluated. The primary intent of the Interim Plan would be to attain a faster implementation for sewer service, where severe needs exist, than would be realized by the other schemes which would service all of the Chenango Valley area. (It was assumed there are "pockets" of severe need, so that general sewer service to the entire Chenango Valley area was not needed immediately). It was initially

thought that this Plan would also have an advantage by delaying the need for a final decision on regionalization, during which time the questions on the Binghamton-Johnson City sewer system and STP would be finally resolved.

Elements of the Chenango Valley Analysis

The Interim Plan analysis consisted of two basic tasks. A "needs survey" was conducted to estimate the severity of the need for sewering in the Chenango Valley, and the spatial distribution of this need. The needs survey consisted of interviews with local officials and an on-site investigation.

The second task, formulation, proposed three approaches to the Interim Plan: local package plants, a temporary subregional system, or a permanent plant with a phased service area.

Needs Survey.

The following departments, officials, and engineering firms, all of whom had some familiarity with, and interest in, the Chenango Valley question, were interviewed: Southern Tier East Regional Planning Board, Broome County Planning Department, City of Binghamton Engineering Department, Broome County Health Department, Town of Chenango Supervisor, Broome County Deputy Commissioner of Public Works, R. J. Martin Consulting Engineer, and V. O. Shumaker, Consulting Engineer.

The statements and opinions obtained from these interviews could not be documented in the sense of actual observation, as the time of the survey was in late July-early August (1975) during a hot, dry period, whereas septic tank failures are most evident during wet spells. However, the persons interviewed were knowledgeable in the area, and covered a wide range of interests. A concensus of these persons was therefore used as a basis for determining the extent of the problem.

The general outcome of these interviews was the following:

a. The need for sewering, as evidenced by septic tank failure, odors, and public demand for sewering, is greatest along the west bank of the Chenango River, from the Broome Community College on the south to Hinman's Corners on the

north. Within this area, the need is a general one, including both the Front Street commerical areas and residential neighborhoods, although demand for sewering is greater near the commercial establishments.

b. Other areas also have problems, but the need is not as great as in the area mentioned above. There is a potential problem in Chenango Bridge, which has some septic tank problems in the general vicinity of the local water supply well, but as yet, there has been no contamination of this well. Generally, the areas of poor soil in Chenango Bridge have a low groundwater table and, where the water table is high, the soil is sandy; thus, severe problems generally do not occur. There are also scattered problems in Kattleville and Fenton.

c. With regard to hardships created by delaying construction of a sewer system, it was generally believed the public would not vote for a plan for installing sewers sooner (say, by 1-2 years) if it would cost them more than a plan which delayed contruction. That is, the hardships of poor septic systems is not considered great enough to suppress personal economic considerations.

In a similar regard, however, the officials felt that doing anything was better than doing nothing, i.e., that even partial sewering would be a benefit to the area.

The field investigation, as stated above, was unable to document the type of problems mentioned by many people (e.g., strong septic odors, sewage running in streams) because of the time of year. The investigation did reveal a bypass pipe at the Broome Community College system, which potentially could be activated in times of high flow (school was not in session at the time of the survey). An examination of the stream to which this bypass leads revealed turbid water and a faint septic odor, which could have been due to bypasses at B.C.C. or residential septic overflows. The beds of other small streams in the area, said to contain sewage at times, were dry.

Formulation Concepts.

The three systems formulated covered the spectrum of issues raised by the committees for the Interim Plan and also considered several hypothetical results of the needs survey:

a. Need exists only in pockets;

b. Need is general throughout Chenango Valley; and

c. Need is intermediate between (a) and (b), i.e., is general over a sizeable area, but not the entire Chenango Valley.

The conclusion drawn from the needs survey was that the area of severe need is the west bank of the Chenango River, from Broome Community College to Hinman's Corners, and that, within the area, the need is a general one. This area, shown on Plate 6 as the First Phase Service Area, was used in the formulation of the systems discussed below.

In the first scheme, a series of package plants would be built, to serve the First Phase Service Area. This area would be subdivided into smaller sub-districts having flows of 50,000 - 100,000 gallons per day, the upper limit of package plant capacity. All local collection systems would be built, along with the necessary interceptor systems to connect to the package plants. Total flows would be about 1.0 mgd so 10 - 20 package plants would be needed, each with its own outfall to the Chenango River.

These small plants would be temporary facilities abandoned at the end of the interim period, i.e., when general sewer service to all of Chenango Valley would be installed. At that time, the regionalization issue would be resolved, based on a better understanding of the Binghamton-Johnson City situation (i.e., the results of the sewer evaluation study and corrective measures).

The second scheme consisted of a temporary subregional STP. A central plant of 1.0 mgd capacity would be built, at the site chosen for the permanent sub-regional plans, near the Broome Community College (Plate 6). After five years of service, a decision would be made to either expand this plant, or abandon it and connect the Chenango Valley area to the Binghamton-Johnson City system.

A permanent plant with a phased service area comprised the third scheme. Initial construction would be the same as in the temporary sub-regional scheme, except the decision would be made now to keep the Chenango Valley service area separate from the Binghamton-Johnson City system. In this approach the "interimness" does not imply a short term use of the STP, but rather, the size of the initial service area (the Phase I service area shown on Plate 6).

Screening of Systems.

The local package plant concept was formulated for servicing pockets of severe need, whereas the results of the survey revealed the need is spread over a fairly wide area and sizeable total wastewater flow (1.0 mgd). The result would be a multitude of STP's and small service areas. Because almost the entire collection and interceptor system would be built, the poor economy of scale in both capital and operating cost associated with these small plants, and the investment in 10 to 20 outfalls which would be abandoned in 5 years, this system would be more costly than the other two and was eliminated from further consideration. Essentially, the rationale for such a scheme was superseded by the needs survey. Also, implementation would be extremely complex, both in construction and operation.

The temporary sub-regional system was eliminated on the basis of logic associated with cost-effectiveness. Comparison of permanent sub-regionalization versus regionalization shows the two plans virtually identical in present worth. It was clear, therefore, that if the sub-regional STP existed, at any reasonable capacity, that it would never be cost-effective to abandon this plant and convert to a regional system. The investment in the outfall, administration building, aeration tank, clarifiers, and chlorine contact unit would be far greater than the net O & M savings associated with the regionalization system.

Therefore, the permanent plant with a phased service area for Chenango Valley was selected as the most suitable for further analysis.

Plan Refinement.

The concept of a smaller initial plant with a phased service area was refined into a plan by the usual process of population and flow projections, design, cost analysis, impact assessment and evaluation.

The population distribution within the Chenango Valley service area and the wastewater projected from the sub-areas within the Chenango Valley area were carefully investigated. If the scope of sewerage service is limited to a smaller area for 5 years after implementation, an STP with an initially smaller capacity could be built to serve Chenango Valley.

The area for initial sewering and STP construction would be limited to the First Phase Service Area shown on Plate 6.

By 1982, sewering and plant capacity would be expanded to the remainder of the Chenango Valley Service Area (Phase 2). These service areas are the ones proposed in the "Amendment to Broome County Sewer Service Plan," R. J. Martin, 1975.

The First Phase of the plan would be designed to serve a population of 8,600 and a flow rate of 1.0 mgd (projected for 1982). By 1982 when this capacity would be exceeded, the treatment plant would be expanded to 2.2 mgd to serve a population of 21,000. This final phase would be adequate to the end of the planning period (2020).

The proposed treatment plant would provide secondary treatment using an activated sludge process. Discharge to the Chenango River would be via a "short outfall" directly east from the STP, just upstream of the Route 81 River Park (see Plate 7).

Essentially, except for the sewer and treatment plant construction phasing and the phasing of the service to population centers, this scheme was identical to the permanent subregionalization plans developed in previous iterations. The environmental impact would therefore be virtually identical for these plans. All water quality standards for primary contact recreation would be met. Although there are no plans for swimming at the Route 81 River Park, unsupervised swimming would undoubtedly take place below the outfall, but should not present a public health problem. Knowledge of the outfall's location may, however, result in an adverse public perception of the Plan.

PLANS FOR FINAL ANALYSIS

At the end of Stage III-1, 4 plans were recommended for final plan analysis and evaluation. The level of treatment, infiltration control, regionalization, and nonstructural measures were specifically defined for each plan.

The relationship between plans developed in Stage III-1 and those selected for final analysis is presented in Table VI-13.

The recommended plans, in addition to the Baseline Condition, included three levels of treatment:

TABLE VI-13

RELATIONSHIP BETWEEN STAGE III-1 AND STAGE III-2 PLANS

Stage III-1 Plans	Features	Stage III-2 Plans	Changes	Rationale
1	Baseline	1	-	Basis for assessment
8	Secondary; 2+3 STP's,[1] 1 mgd infiltration control storm overflow control	2	STP's: 2+3 (Plan 2A), 3+3 (Plan 2B), 3+3 (Phased Plan 2C)	Determine optimal degree of regionalization to achieve minimum instantaneous 4 mg/1 DO
2, 3	Secondary; Nitrification @ Binghamton-Johnson City; STP's: 2+2 (Plan 2), 3+3 (Plan 3); 3 mgd infiltration control; storm overflow control	3	STP's: 2+3 (Plan 3A), 3+3 (Plan 3B), 3+3 (Phased Plan 3C)	Determine optimal degree of regionalization to achieve minimum daily average 5 mg/1 DO
4	Advanced Waste Treatment; 2+2 STP's; 3 mgd infiltration control; non-structural measures; storm overflow control	4	-	Approach Corps of Engineers' definition of zero goal by 1985

[1] (2+3) STP's refers to the number of Sewage Treatment Plants in Broome County and Tioga County, respectively.

1. Maintain the minimum instantaneous DO level in the Susquehanna River above 4.0 mg/l.

2. Maintain the minimum daily average DO level above 5.0 mg/l.

3. Approach the Corps of Engineers' definition of zero discharge of pollutants in accordance with the 1985 goal.

Secondary treatment (Plan 2) would be sufficient to achieve the minimum instantaneous 4 mg/l DO level. To maintain a minimum daily average DO level of 5 mg/l, nitrification would be added at the Binghamton-Johnson City STP (Plan 3). Advanced waste treatment systems would be applied to all plants to meet or approach the Corps of Engineers' definition of the 1985 goal of zero discharge.

In conjunction with each treatment level, overflow control facilities (microstrainers) for the City of Binghamton would be provided to handle excess stormwater.

The optimal numbers of STP's varied with the level of treatment. For the AWT system, four plants were cost-effective: Binghamton-Johnson City and Endicott in Broome County and Town of Owego STP's No. 1 and No. 2 in Tioga County.

For plans achieving 4 or 5 mg/l DO, three plants in Tioga County were optimal: Town of Owego STP's No. 1 and No. 2 and Owego Village STP. For Broome County, the most effective degree of regionalization was uncertain, and at the time, was felt to depend upon the results of a sewer evaluation study for Binghamton. The question centered on whether to treat Chenango Valley wastes (currently not sewered) at the Binghamton-Johnson City plant or to construct a separate facility at Chenango Valley. Three schemes were developed to handle wastewater in Broome County: (1) regionalization - Binghamton-Johnson City and Endicott STP's [Plans 2A and 3A]; (2) sub-regionalization - Binghamton-Johnson City and Endicott STP's and a new Chenango Valley STP [Plans 2B and 3B]; and (3) Sub-regionalization with a phased plan for Chenango Valley [Plans 2C and 3C].

INSTITUTIONAL ANALYSIS

In the previous iteration, wastewater, stormwater, and sludge management components were integrated into complete technical systems. To form a complete wastewater management plan, however, an analysis and evaluation of the required political and institutional arrangements was necessary. Institutions as defined in this Study were organizations which implement and control wastewater management systems. The purpose of this analysis was to assess the appropriateness of the existing institutional arrangements (analogous to the baseline condition) in implementing wastewater management plans. Where shortcomings were identified, modifications to the existing structure or new arrangements were suggested. These suggestions aim to provide the needed direction with a minimum amount of disruption to the existing institutions. In this way. the implementation and management of any plan can be made more efficient and equitable.

Existing Institutions

The Broome-Tioga region is generally characterized by a large number of municipal departments and town districts created to finance water and sewage works. Public water supplies and sewage collection and treatment are managed by municipal departments (e.g., public works, engineering and sewer departments) in the villages and the City of Binghamton. In towns, the town districts and municipal departments usually operate together.

A district differs from other service arrangements such as municipal departments, intermunicipal agreements, and authorities, primarily in two ways: (1) a referendum is required to form a district, and (2) it has the power to tax property. Also, there is an important difference between the revenues which can be derived from municipal departments and districts. While village or city departments may realize a profit on their investment in wastewater management, town districts may only raise enough revenues to cover debt service and operating costs.

Binghamton-Johnson City Joint Sewage Treatment Plant.

The Binghamton-Johnson City Joint Sewage Treatment Board was created by an intermunicipal agreement between the City of Binghamton and Johnson City in order to jointly treat their wastes. Both municipalities have an equal voice in deciding the affairs of the treatment system. Responsibilities for sewers are assigned to various departments. Outside users that have contracted for service include: portions of the Towns of Binghamton, Kirkwood, Dickinson, Union, and Vestal; the Village of Port Dickinson and the State University of New York at Binghamton. Costs are allocated by formulas based on metered water consumption.

Endicott Water Pollution Control Plant.

The plant is owned and operated by a subdepartment of the Village. In addition to the Village, the service area includes Endwell, Park Manors, North Endicott, West Endicott, West Corners, and Airport Heights. Endicott does not directly bill users for sewage. Cost apportionment is based on the valuation of taxable property. Endicott has recently signed an agreement with Vestal to provide service to a large portion of that town.

Village of Owego Water Pollution Control Plant.

The plant is owned by the Village of Owego and operated by a sewage department. There are no outside users of the Village system and no common service functions between Owego Village and Owego Town. The costs of treatment are paid entirely by the local population at a metered rate.

Owego Town Water Pollution Control Plants #1 (West) and #2 (East).

These plants are financed by the sewer districts tributary to them. The Town government provides administrative support for the districts, but sewage treatment is currently not a Town function. Revenues to support the plants are by flat rate user fees for residences and by metered rates and estimated consumption for industries and nonresidential users.

Impacts of Technical Plans on Existing Institutions

The analysis of existing institutions, like the Baseline Condition, was used as a basis for assessment to determine the impacts of wastewater management plans.

A number of criteria were used to demonstrate the ability of an institution to deal effectively with the impacts of a technical plan. The more an institution was considered able to meet those criteria, the better the chances were for effective plan implementation.

There were six major criteria selected to best define comprehensive wastewater management. These were: planning capabilities, financial capabilities, property acquisition, construction and facility maintenance, administration, and system operation. These six criteria were further expanded to the following:

a. Ability to plan for entire service area and area affected by the technical alternatives. The service areas are those serviced by an individual treatment facility or planning agency, depending on the context of the institution and the technical alternatives.

b. Ability to utilize revenues for operation. This criterion refers to the management of treatment plants. An institution should be able to receive adequate funds for operation and dispense the money to properly maintain the facilities.

c. Ease of obtaining Federal funds. The institutions should be capable of following guidelines necessary for obtaining grants; presenting a clear case for the need of grant assistance, and being able to get on priority lists.

d. Ability to achieve economies of scale. The institutions should be capable of building and operating facilities that have high economies of scale given a system of logistics and treatment levels. The ability to achieve economic levels of infiltration control is considered to be integral to this criterion.

e. Ability to acquire rights-of-way and implementation capabilities. The institutions should be capable of acquiring land by eminent domain and/or negotiation, and have the authority for the implementation of a given technical alternative.

f. Ability to construct and maintain wastewater management facilities. The institutions should have the financial and administrative capability to construct and maintain facilities.

g. Ability to acquire and maintain staff. The institutions should be able to attract and keep properly trained professional personnel to operate, maintain, and monitor facilities.

h. Decision-making capabilities. The institution should be able to make decisions relevant to its functioning without having to gain the approval or review of too many other higher agencies.

i. Ability to operate facilities. The institutions with responsibility to operate facilities should be able to perform such activities.

j. Ability to negotiate for or maintain a spectrum of services. There should be opportunities and provisions to provide other services in addition to wastewater management.

k. Ability to enforce powers. The institution should be capable of enforcing agreements and control factors necessary to the proper execution of its responsibilities.

l. Compatibility with existing levels of government. The institutions should be capable of being modified or created with a minimum amount of negotiations, legislative changes, and shifts of decision-making authority.

m. Ability to promote public participation. The institution should be favorable toward and encourage public participation in the development of its programs, and have arrangements to do so.

n. Political compatability. An institution must be capable of integrating its functions with political processes that might place demands on it.

o. Ability to assign costs to those who receive benefits. The institution should be capable of enforcing a change mechanism whereby everyone who receives the benefits from wastewater management will contribute towards the economic costs of implementing a technical alternative. Every person who would benefit from an improvement in water quality or a maintenance of high quality conditions should contribute to the costs of achieving such quality.

Generally, the region as a whole would benefit from improved quality and more specifically, individuals downstream of discharges would benefit.

p. Ability to assign costs to those who create costs. The institutions should be capable of enforcing a charge mechanism whereby those who create the needs for a given technical alternative will pay the economic costs of implementing that alternative. Every individual who discharges wastes to a treatment plant should incur the financial cost of treating those wastes. It should be noted that criteria "o" and "p" are closely related and sometimes conflict with each other. Those who receive the benefits are not necessarily those who pay the costs. The purpose of using two criteria instead of a single benefit/cost criteria for accounting purposes is to demonstrate the advantages and disadvantages of fragmented institutions and a regional approach.

The degree to which each of the local institutions could meet the requirements for each technical plan was presented in matrix form. A numerical ranking system was used to indicate the degree to which each institution achieved the stated criteria.

The complete evaluation is presented in the Institutional Analysis Appendix. In summary, the weak areas of the existing institutions are basically with Federal grants, the maintenance of adequate staff and in assigning costs in an equitable way to those who receive the benefits. The most apparent detriment to the existing system is the fact that to obtain construction grants, several requirements must be met (user fees, metering, and industrial cost recovery by treatment plants), and none of the systems have completely complied with these requirements. The existing institutions have minimal funding ability because of this non-compliance with Federal regulations. In addition, the size of the area and population affected are criteria for receiving grants, and in the case of the existing institutions, the areas are somewhat fragmented.

Schemes for Institutional Arrangements

There were six institutional arrangements proposed for the implementation of the technical plans. These arrangements affect in varying degrees the service areas of Binghamton-Johnson City, Chenango Valley, Endicott, Owego Village, West Owego, and East Owego. They are:

1. Existing Institutional Arrangements.

2. Minor Modifications to the Existing Arrangements.

3. Expanded County Sewer District for the Binghamton-Johnson City Service Area.

4. Expanded County Sewer Authority for the Binghamton-Johnson City Service Area.

5. County Sewer Departments in Broome and Tioga Counties to Manage Wastewater Functions.

6. One Bicounty Authority to Absorb Functions of Existing Institutional Arrangements in both Counties.

Existing Institutional Arrangements.

Current responsibilities and functions of Federal, State, regional, and local agencies and wastewater management bodies directly influencing wastewater management programs would be maintained.

Minor Modification to Existing Arrangements.

This modification would involve minor changes to local level existing institutions. Basically, these changes would be to help the existing institutions comply with Federal requirements for construction grants; for example, (1) the use of metered rates for sewage treatment; (2) the construction of user fee schedules for industrial users along with cost recovery mechanisms; and (3) the creation of reserve funds. To implement these suggestions in all service areas, these steps would be necessary:

1. The Binghamton-Johnson City Joint Sewer Board would have to adopt these measures, and then, the City of Binghamton (through the mayor and council) and Johnson City (through the mayor and trustees) would have to give approval.

2. The village service areas of Endicott and Owego (through the village mayors and trustees) would need to adopt these measures. In Owego Town, the supervisor and councilmen would decide the issue. There should be no difficulty with these procedures, as these modifications would improve the functioning of the existing institutions without usurping their jurisdictional powers.

Expanded County Sewer District for the
Binghamton-Johnson City Service Area.

This arrangement proposed that the existing Broome County Sewer Agency, whose members are appointed by the County Executive, be responsible for carrying out the construction, operation, and maintenance of treatment facilities, and regional and local collection systems. Smaller existing county and town districts would only be vehicles to finance new sewerage, not to maintain facilities or to control discharges. This arrangement would unify the control over sewers and treatment, and would remove certain municipal functions (local sewers) to the county (district) level.

To implement this arrangement, negotiations would have to be carried out, mainly between the Agency and the Binghamton-Johnson City Joint Sewer Board as the Board would be losing its power. Furthermore, other municipalities, once served by the Joint Board, would need to make arrangements transferring the management of their collection facilities to the Agency. The negotiation stage alone could take from one to two years.

Furthermore, some payment to Binghamton and Johnson City may have to be made to compensate those municipalities for carrying the costs of a partly underused facility. (This is in regard to the primary units; the secondary facility is near capacity.) Perhaps a preferential sewage rate could be used for that purpose.

Suggestions for the other service areas are:

1. The Village of Endicott, through its Mayor and Board, would continue to manage the Endicott plant.

2. For Tioga County, Owego Village could consolidate its functions with Owego Town and pay the Town for managing, operating, maintaining, and staffing the Village plant. This could be arranged through an intermunicipal agreement. Otherwise, the Town of Owego and the Village of Owego could continue to manage their own treatment plants and collection systems.

The areas of Endicott, Owego Town, and Owego Village would not be extremely altered. The central issue is, however, would the Joint Sewer Board transfer its powers to the Agency? With the advantages of unified control over the sewer system, plus compensation, such an attempt at negotiation would be worthwhile and seems quite feasible. The removal of certain municipal functions to the county level

is not without precedent. The formation of a district would be subject to referendum.

Expanded County Sewer Authority for the Binghamton-Johnson City Service Area.

The Authority could consist of three or five members appointed by the Broome County Legislature, and would function similarly to the expanded district. (This is only an example of what could happen as each authority formed has different composition and approval mechanisms. There is no uniform authority law in New York.) In order to create this arrangement, a special enactment of the State Legislature would be necessary. However, the authority would not subject it to the referendum requirements of a district, nor would its budget be subject to yearly approval by the local municipalities or by the Broome County Legislature.

While Binghamton, Johnson City, and the Chenango Valley are the areas that would be affected, Endicott and the Owego municipalities would remain functioning in the same manner.

Although the Authority can provide a streamlined budgetary and decision-making process, there are some problems with this institutional arrangement. First, New York State does not encourage the establishment of authorities, and the time it takes the State to vote upon the arrangement is unpredictable. Second, the Authority can only float a revenue bond at a higher interest rate, and third, the independence of an authority can result in the authority losing touch with the concerns of local institutions.

County Sewer Departments.

County departments can be created to absorb all sewage collection, treatment functions, and the financing of local collection extensions. The department would assume the indebtedness of the existing treatment facilities and regional collectors.

A major difference between the department from the authority and district is that the financing possibilities are not limited. The county department may receive its capital expenditure funds via the general county property tax, and operation and maintenance expenses from a metered rate of sewer system users without totally depending upon special user fees.

To implement this arrangement, a mandatory referendum (requiring approval by Binghamton City voters, by the majority of villages, and by the majority of towns) would be needed. And, in addition to the referendum requirement, negotiations would be necessary to transfer ownership of the treatment facilities to the county.

This arrangement would be best for the Advanced Waste Treatment Alternative because it could spread the costs of the treatment uniformly to a larger area. For example, Endicott users would pay the same unit charges for use of the sewers as the Binghamton-Johnson City users. To use this arrangement for the other technical alternatives would unnecessarily disrupt the jurisdictional power base of the existing institutions.

Two-County Sewer Authority.

An authority, encompassing both the Broome and Tioga County Study areas, would own, operate, and maintain all sewage and treatment facilities, and would assume remaining indebtedness of existing treatment and regional collection facilities. The authority would continue to rely on town districts to finance new sewage extensions and on existing municipal corporations to repay existing local system extension bonds. Rates would be equalized ac oss the two-county region for sewer system operations and all treatment extension bonds.

To implement this arrangement, the State legislature would be needed to create the authority. This process would be difficult because in New York State, there is considerable distrust of large, semi-autonomous agencies, and a considerable amount of politicing at the State level would have to be done, creating an uncertain time frame for the formation of the Authority.

Evaluation

The same criteria and ranking systems used to evaluate the effectiveness of the existing arrangements were applied to the institutional schemes to determine the best implementation and management arrangement for each technical plan.

The findings were as follows:

1. For Plans 2 and 3 (achieving 4 and 5 mg/l DO, respectively), the Modified Institutions and the Part County Sewer District appeared to offer the most promising contributions toward plan implementation. Since the capital improvements required by these plans are not large, and the local institutions are capable with regard to construction and operation, the inclusion of a "minimal institutional change plan" was advisable.

2. The Expanded County District was recommended since only the Binghamton-Johnson City Service area is affected. Relative to the Part-County Authority, the District had the advantage of being formed by local initiative without State legislative approval. Furthermore, with Plans 2 and 3, the District had an advantage over the county, department, and Two-County Authority by not involving other service areas with Binghamton-Johnson City problems. The District was recommended because it represented the minimal institutional change necessary to integrate wastewater collection and treatment in the most complex service area i.e., Binghamton-Johnson City).

3. The County Departments and Bicounty Authority institutions were recommended for detailed plan refinement for Plan 4 (AWT). If the region is really committed to undergo the expense of this treatment level, the institutions should be capable of completely integrating the waste collection and treatment functions and take a regional approach in programming facilities and hiring personnel.

Therefore, each plan (except the Baseline) has two suggested institutional arrangements as shown in Table VI-14.

SUMMARY

In this final iteration four plans were recommended, providing a range of choice for the local and State decision making process. Three of the plans would implement measures to provide water quality above that projected for the Baseline Condition. Each of these 3 "action plans" has two alternative methods of institutional arrangements for implementation and management. Two of the plans provide 3 approaches for regionalization in Broome County: treatment of Chenango

Valley wastes at Binghamton-Johnson City; a separate STP for Chenango Valley; and a separate STP with an initially reduced service area and smaller plant capacity. The third action plan would employ AWT to approach the Corps of Engineers' definition of the 1985 zero discharge goal.

The 4 plans and their associated impacts are described in Chapter VII with a comparison and evaluation presented in Chapter VIII.

TABLE VI-14

SUMMARY OF INSTITUTIONAL ARRANGEMENTS AND TECHNICAL PLANS

Plan	Treatment Level	Number of Plants		Phased Chenango Service Area	Institutions
		Broome	Tioga		
1	Baseline	2	3	-	Existing[1]
2A-1 -2	Secondary	2	3	-	Modified[2] District[3]
2B-1 -2	Secondary	3	3	-	Modified[2] District[3]
2C-1 -2	Secondary	3	3	Yes	Modified[2] District[3]
3A-1 -2	Sec. + Nitr. @ B-JC	2	3	-	Modified[2] District[3]
3B-1 -2	Sec. + Nitr. @ B-JC	3	3	-	Modified[2] District[3]
3C-1 -2	Sec. + Nitr. @ B-JC	3	3	Yes	Modified[2] District[3]
4-1 -2	Adv. Waste Treatment	2	2	-	County Dept.[4] Two County Authority[5]

[1]Existing Institutions
- the institutional baseline
- management and fiscal activities remain unchanged and the responsibility of those agencies currently designated in the local area.

[2]Modified Institutions
- metered rates for sewage treatment
- user fees and industrial cost recovery
- reserve funds
- possible subsidies to low income families
- possible modifications to the Binghamton-Johnson City Joint Sewage Board Standard Agreement
- modifications of the Southern Tier East Regional Plan

[3]Expanded County District in the Binghamton-Johnson City service area, a County District to
- own, operate, and maintain all sewage collection and treatment facilities
- plan, construct, and finance treatment facilities
- rely on local collection districts to finance new sewerage extensions
- recover costs from individual users
- equalize sewage treatment fees in each county.

TABLE VI-14 (Continued)

[4]County Department
- county sewer departments created in Broome County and Tioga County to:
- own, operate, and maintain all sewage collection and treatment facilities
- rely on local collection districts to finance new sewerage extensions
- recover costs from individual users
- equalize sewerage treatment fees in each county

[5]Two-County Authority
- two-county sewer authority created by the State Legislature to:
- own, operate, and maintain all sewage collection and treatment facilities
- plan, construct, and finance treatment facilities
- rely on local collection districts to finance new sewerage extensions
- recover costs from individual users
- equalize sewage treatment fees in the region.

CHAPTER VII

PLANS FOR CHOICE

Chapters IV, V, and VI described the plan formulation process through the three major stages of the Study. The product of Stage III-2 was 4 plans from which a selection for the final recommendation was made. These 4 "Plans for Choice" are described in this Chapter along with a discussion of their expected impacts. Chapter VIII presents an evaluation and comparison of the 4 Plans for Choice, and in Chapter IX the plan recommended by the ISMG is discussed.

In this Chapter all components of the final four wastewater management plans are presented. In addition to the technical aspects, the detailed refinement of plans specifies the activities which should be undertaken for proper plan implementation and management. This refinement is further divided into the following programs:

1. Capital improvements
2. Management
3. Revision (planning activities)
4. Implementation

These programs are detailed in the Institutional Analysis Appendix. A more complete description of the technical components can be found in the Design and Cost Appendix.

The "capital improvements program" of a wastewater management plan includes capital requirements for new facilities as well as capital improvements to existing facilities requiring modification.

The "management program" embraces a broad range of activities that do not necessarily involve major construction or

engineering activities. Management programs specify: (1) the powers and membership composition of the implementing institution; (2) the fiscal programs such as user fees, cost-sharing, and development financing; (3) public education; and (4) manpower requirements and training.

The "revision program" specifies the continuing planning activities which should be undertaken with respect to identifying needs, alternatives, and evaluation. In assuring the flexibility of the selected plan, and providing a continuing responsiveness to changing needs, the revisions program embraces the activities of those institutions charged with the continuous function of wastewater management planning. This program is divided into two sections. The first is called the "five year revision" and specifies activities to be undergone to monitor the plan and suggest changes. The second section is called the "decision-oriented revision" which specifies analyses which should be undertaken when various conditions arise. The latter section differs from the five year revision in that the activities address conditions which can only be speculated about at this date.

The "implementation program" focuses upon major actions needed to carry out the plan. In its simplest form, the implementation program is a set of discrete actions that takes the plan from the drawing board conceptual stage and places it into actual operation. The program specifies the steps which must be taken to create new institutions and it delineates other activities (primarily to meet grant requirements) necessary for plan implementation.

The necessary steps can be categorized under: (1) agreements, (2) the fulfillment of State and Federal planning requirements, (3) the fulfillment of State laws for establishing districts and setting bonding regulations, and (4) the scheduling of construction time.

Although some attempt will be made to estimate the time necessary for plan implementation, no definitive statement can be made. For example, in the formation of agreements, no exact time limit can be given because agreements are affected by the time necessary for political bodies to arrive at a decision. Sometimes agreements are made rapidly on the rder of a month; at other times, years are involved. Therefore, range of times is provided to indicate the time necessary to complete the stages. A summary of the final Plans for Choice is shown in Table VII-1 and discussed by plan in the following text.

TABLE VII-1

FINAL PLANS FOR CHOICE

Plan No.	Description	Year 2020 DO Levels with Daily Pollutant Loadings @ MA-7-CD-10 Flows: Minimum Instantaneous	Year 2020 DO Levels with Daily Pollutant Loadings @ MA-7-CD-10 Flows: Minimum Daily Avg.	Number of Plants: Broome Co.	Number of Plants: Tioga Co.	Binghamton Infiltration Control (mgd)	Non-Structural Measures	Institutions	Implementation Time Frame** (Years)
1	Baseline	3.0	3.5	2	3	0	None	Existing	-
2A	Secondary	3.9	4.4*	2	3	1.0	None		
-1								Modified	3-5
-2								District	3-6½
2B	Secondary	4.0	4.5*	3	3	1.0	None		
-1								Modified	4-5½
-2								District	4-5½
2C	Secondary	4.0	4.5*	3	3	1.0	None		
-1	(Phased Service)							Modified	4-6
-2								District	4-6
3A	Sec. + Nitrification	4.9	5.4	2	3	3.0	None		
-1								Modified	3½-5
-2								District	3-6½
3B	Sec. + Nitrification	5.0	5.5	3	3	3.0	None		
-1								Modified	4-5½
-2								District	4-5½
3C	Sec. + Nitrification	5.0	5.5	3	3	3.0	None		
-1	(Phased Service)							Modified	4-6
-2								District	4-6
4	Adv. Waste Treatment	6.2	6.7	2	2	3.0	Pricing & Education		
-1								County Dpt.	Varies
-2								Two-County Authority	Varies

* Contrevention of NYSDEC standard for minimum daily average DO (5 mg/l) may occur after 1994.
** Average for Urban Study Area.

PLAN 1 - BASELINE PLAN

The 1977 Baseline Plan, essentially a "no action" plan, established the basis for the impact assessment of the "action" plans. This baseline projected the impacts which would result (by year 2020) if the Bicounty Area's wastewater management systems remained unchanged from those presently planned for the year 1977. The plan consisted of a static physical system subjected to projected future conditions, i.e., increased population and wastewater flows.

EXISTING PRIORITIES

In defining the environmental, social, and economic projections for the Baseline Plan, it was assumed no wastewater treatment facilities would be added other than those already approved by New York State Department of Environmental Conservation (NYSDEC) for construction prior to 1977. Expansion of the present service areas was assumed to continue along existing trends. The additional interceptors approved by NYSDEC for funding by 1977 were included in the Baseline Condition, except for the Chenango Valley interceptor as Broome County was studying other alternatives. Those sewers providing service for growth areas that are included in the Broome County Sewerage Feasibility Plan were also assumed to be in the 1977 Baseline Plan. The locations of treatment plants, interceptors, and service areas for this plan are depicted in Plate 3. The following is a description of the facilities in the Baseline Plan that are ranked by NYSDEC for funding prior to 1977.

Owego Village: An interceptor, pump station, and a force main to serve all areas south of the river and within the Village; part of River Road and the Valley View Heights Subdivision; the area within the Village lying west of the creek; and the low area lying east of the Court Street Bridge, including Lackawanna Avenue and Route 17. The existing primary treatment plant will be upgraded to provide for secondary treatment. This project is scheduled for funding in 1976.

Town of Union: Extension of sanitary sewers to the Choconut Center area of the Town of Union is scheduled for funding in 1975.

Town of Vestal: An interceptor sewer to the Endicott Sewage Treatment Plant (STP) is scheduled for funding by 1977. This interceptor will serve the western portion of the Town of Vestal which is currently served by a primary treatment plant (to be abandoned).

Town of Owego: An interceptor serving the eastern part of the town and connecting to Owego STP #2 is scheduled for funding 1977.

MUNICIPAL WASTEWATER MANAGEMENT

Regionalization of STP's

The Broome County plants would be the existing Binghamton-Johnson City and Endicott STP's. The Chenango Valley area would not be sewered. Tioga County plants would be the existing Town of Owego STP's No. 1 (West Owego) and No. 2 (East Owego) and the Village of Owego STP. The Vestal STP would be abandoned with diversion of its sewage via a new interceptor to the Endicott STP. The Owego Valley View imhoff tank would be abandoned with diversion of its sewage to an upgraded Owego Village STP. Extensions of sewage collection and treatment services would take place within the Nanticoke Creek Valley (to the Endicott STP) and toward Five Mile Point (to the Binghamton-Johnson City STP). Service areas and interceptors included in this plan are shown in Plate 3.

Treatment Levels and Processes

The Owego Village STP would be upgraded to provide secondary treatment. The remaining STP's which currently provide secondary treatment would not be expanded or upgraded although the sewered population and sewage flows to all STP's would continue to increase. The Chenango Valley area would continue on septic systems.

Infiltration Control Level in the City of Binghamton

Under the Baseline Condition, no control measures would be implemented and infiltration would remain at its current average daily level of about 7.5 mgd.

Nonstructural Measures for Flow Reduction

Nonstructural measures for flow reduction would not be applied under the Baseline Condition.

STORM OVERFLOW MANAGEMENT

Combined sewer overflows in the City of Binghamton and Owego Village systems would continue to discharge untreated sewage and stormwater to the Susquehanna and Chenango Rivers.

SLUDGE MANAGEMENT

Sludge management practices would continue with existing handling and disposal methods.

CAPITAL IMPROVEMENTS PROGRAM

With two exceptions, the above baseline projects were assumed to be on-line prior to 1977 and therefore, no capital costs for these projects have been presented. For implementation by 1977, some degree of uncertainty does exist for the upgrading of the Owego Village STP, as much discussion had centered on the design of this facility and would

likely delay construction; and for the Nanticoke Valley interceptor, as this project is current not rated by NYSDEC for funding. The capital costs associated with the Baseline Plan include the regional interceptor to Nanticoke Valley ($1.57 million) and the upgrading of the Owego Village STP ($1.02 million). The cost for upgrading the Owego Village STP was based on using a trickling filter process; however, recent NYSDEC plans call for an activated sludge process.

COST SUMMARY

The present worth costs for this plan are: capital - $2.6 million, O & M - $19.5 million, and replacement - $9.8 million, for a total cost of $31.9 million. The present worth costs for each service area are presented in Table VII-2.

MANAGEMENT PROGRAM

The institutions currently responsible for wastewater management would continue to use existing management policies and programs.

TABLE VII-2

PLAN 1 (BASELINE) COSTS
PRESENT WORTH (MILLION $'s)[1]

	Binghamton-Johnson City	Endicott	East Owego	West Owego	Owego Village	TOTAL
Wastewater Treatment						
Capital	-	-	-	-	1.0	1.0
O & M	7.3	4.0	1.6	0.4	0.7	14.0
Replacement	4.7	3.3	0.6	0.1	0.3	9.0
TOTAL	12.0	7.3	2.2	0.5	2.0	24.0
Interceptors						
Capital	-	1.6	-	-	-	1.6
O & M	-	-	-	-	-	-
Replacement	-	-	-	-	-	-
TOTAL	-	1.6	-	-	-	1.6
Storm Overflows						
NONE						
Infiltration Control						
NONE						
Sludge						
Capital	-	-	-	-	-	-
O & M	3.8	0.7	0.5	0.2	0.3	5.5
Replacement	0.3	0.2	0.1	0.1	0.1	0.8
TOTAL	4.1	0.9	0.6	0.3	0.4	6.3
Totals						
Capital	-	1.6	-	-	1.0	2.6
O & M	11.1	4.7	2.1	0.6	1.0	19.5
Replacement	5.0	3.5	0.7	0.2	0.4	9.8
TOTAL PLAN COST	16.1	9.8	2.8	0.8	2.4	31.9

[1] Based on 50 year economic life @ 6 1/8% and ENR = 2248.

PLAN 2A

The intent of this plan was to maintain minimum instantaneous DO levels above 4 mg/l in the Susquehanna River during both low flow and storm overflow conditions. Plans 2A, 2B, and 2C are similar except for the degree of regionalization.

MUNICIPAL WASTEWATER MANAGEMENT

Regionalization of STP's

The Broome County plants would be the existing Binghamton-Johnson City and Endicott STP's. The wastewater generated from the entire Chenango Valley service area would be treated at the Binghamton-Johnson City STP. Tioga County plants would be the existing Town of Owego STP's No. 1 (West Owego) and No. 2 (East Owego) and the Village of Owego STP.

Service areas and interceptors included in this plan are shown in Plate 5. The only additional regional interceptor to those included in the Baseline Plan, would connect the Chenango Valley service area to the north end of the City of Binghamton wastewater collection system.

Treatment Levels and Processes

All plants would maintain a level of treatment at least as high as is presently being attained and in no case would either the minimum secondary standards or the stream standards be contravened. The existing activated sludge processes would be used at the Binghamton-Johnson City STP and at the Town of Owego STP No. 2. The existing trickling filter processes would be used at the Endicott STP and the Town of Owego STP No. 1. The Village of Owego STP would be upgraded to secondary treatment using a trickling filter process (recently changed to an activated sludge process).

Infiltration Control Level in the City of Binghamton

For the level of treatment (secondary) and the regionalization scheme assumed in this plan, an infiltration reduction of 1 mgd was found to be economically justifiable.

Nonstructural Measures for Flow Reduction

In this plan, the Village of Endicott and the Town of Owego would institute metered user rates. The increased price of water to the consumer should result in a reduction of water consumption, and therefore, wastewater flows. An educational program to encourage the use of water saving devices could result in an estimated 20 percent reduction in the projected incremental increase in per capita flows. Although such a program could be undertaken, no formal educational activities were specified in this plan.

STORM OVERFLOW MANAGEMENT

Microscreening units followed by chlorination would be provided near five overflow sites (see Figure VII-1 in the Impact Assessment section of this Chapter). This system would maintain a minimum DO of 4 mg/l during design storm conditions. A detailed description of the overflow treatment system is given in Chapter V and the Design and Cost Appendix. An estimate was also made of the costs of inflow control and microscreening treatment for the Village of Owego combined sewer system.

SLUDGE MANAGEMENT

Several sludge management techniques have been analyzed in Chapter V and in the Design and Cost Appendix. The land application of liquid sludge was recommended, with landfill of dewatered sludge provided as a backup alternative.

CAPITAL IMPROVEMENTS

Expansion of the existing wastewater facilities would be required during the planning period to handle the increasing flow expected. The construction schedule for this expansion, the required interceptors, stormwater control facilities and infiltration control is presented in Table VII-3.

TABLE VII-3

PLAN 2A CAPITAL IMPROVEMENTS

Service Area	New Total Capacity (mgd)	Year	Description
Binghamton-Johnson City	2.2	1977	Chenango Interceptor
	1.0	1977	Infiltration Control
	39.5	1977	Storm Overflow
	29.0	1977	Raw Wastewater Pumping
	26.5	1977	Aerator and Clarifier
	29.0	1997	Primary Tank
	30.5	2025	Aeration and Clarifier
Endicott	0.8	1977	Nanticoke Valley Interceptor
	9.2	1983	Additional Secondary Treatment Capacity
East Owego	3.0	1992	General Expansion
West Owego	0.7	2000	General Expansion
Owego Village	1.0	1977	New Secondary Treatment Capability
	-	1977	Inflow Control
	3.0	1977	Micro-screening

COST SUMMARY

The present worth costs for this plan are: capital--$13.5 million, O&M--$22.1 million, and replacement--$11.6 million, for a total cost of $47.2 million. The present worth costs for each service area are presented in Table VII-4.

MANAGEMENT AND IMPLEMENTATION PROGRAM

Plan 2A-1: Minor Modifications to Existing Institutions.

The Broome County Sewer Agency would manage the Chenango Valley regional collection system and act as intermediary between the Binghamton-Johnson City Joint Sewage Board (B-JCJSB) and Fenton, Chenango, and Dickinson users. The Joint Sewage Board would continue to manage the treatment plant. The Towns of Chenango, Fenton, and Dickinson would manage their own sewer collection systems.

Endicott, Union, and Owego Town should convert from flate rates and property tax to metered rates and industrial surcharges. The Broome County Sewer Agency should institute metered rates and user fees in Chenango Valley. All Federal grant recipients should implement industrial grant recovery and create sinking funds. Portions of grant recovery could subsidize low income families at the discretion of the grant recipient.

The BJCJSB would continue with the existing cost sharing agreement with the following modifications: (1) the Broome County Sewer Agency should finance in 1977 the portion of the new construction at the Binghamton plant attributable to Chenango Valley (one set of aeration and clarifier units) (2) all debt service contributions by outside municipalities on new construction should be exempt from the 25 percent surcharge. The Towns of Maine and Union should share the Nanticoke Valley interceptor costs according to the projected flow from each.

TABLE VII-4

PLAN 2A PRESENT WORTH[1]
(MILLION $'s)

	Binghamton-Johnson City	Endicott	East Owego	West Owego	Owego Village	TOTAL
Wastewater Treatment						
Capital	1.6	1.3	0.5	0.1	1.0	4.5
O & M	7.8	4.4	1.9	0.4	0.7	15.2
Replacement	5.1	3.6	0.7	0.1	0.3	9.8
TOTAL	14.5	9.3	3.1	0.6	2.0	29.5
Interceptors						
Capital	2.5	1.6	-	-	-	4.1
O & M	-	-	-	-	-	-
Replacement	-	-	-	-	-	-
TOTAL	2.5	1.6	-	-	-	4.1
Storm Overflows						
Capital	3.6	-	-	-	1.0	4.6
O & M	0.8	-	-	-	0.1	0.9
Replacement	0.9	-	-	-	0.1	1.0
TOTAL	5.3	-	-	-	1.2	6.5
Infiltration Control						
Capital	0.2	-	-	-	-	0.2
O & M	-	-	-	-	-	-
Replacement	-	-	-	-	-	-
TOTAL	0.2	-	-	-	-	0.2
Sludge						
Capital	0.05	0.01	0.005	0.001	0.002	0.1
O & M	4.3	0.7	0.5	0.2	0.3	6.0
Replacement	0.3	0.2	0.1	0.1	0.1	0.8
TOTAL	4.7	0.9	0.6	0.3	0.4	6.9
Totals						
Capital	8.0	2.9	0.5	0.1	2.0	13.5
O & M	12.9	5.1	2.4	0.6	1.1	22.1
Replacement	6.3	3.8	0.8	0.2	0.5	11.6
Total Plan Cost	27.2	11.8	3.7	0.9	3.6	47.2

[1]Based on a 50 year economic life @ 6 1/8% and ENR = 2248

Plan 2A-2: Expanded County District for Binghamton-Johnson City Service Area

Due to differences in institutional arrangements, Plan 2A-2 would differ from Plan 2A-1 in the following areas. The Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City plant rather than the Joint Sewage Board. The BCSA would also be responsible for writing standards for new sewer construction and connections.

The Binghamton-Johnson City Area would do the following:

1. All individual users would contribute towards all debt service, treatment and collection, O & M, and sewer rehabilitation costs.

2. New regional collectors would be financed through separate county districts.

3. Existing and new local collection debt services would be financed by local municipalities.

Implementation

This plan fulfills most EPA requirements for Step 1, facilities planning (Section 201 of P.L. 92-500). The average estimates time frame to complete the remaining steps for Step 1, detailed design (Step 2), construction (Step 3), and formation of the necessary institutions would be 3 to 5 years for Plan 2A-1 and 3 to 6 1/2 years for Plan 2A-2, following plan selection and approval.

REVISION PROGRAM

Plan 2A-1

Five Year Revision.

The following activities should be considered five years after plan selection.

1. Revise wastewater flow projections

2. Determine effectiveness of infiltration control measures

3. Determine need for sewerage extensions

4. Assess stream standards based on water quality monitoring

5. Review performance of treatment facilities

6. Evaluate effectiveness of land application of liquid sludge.

The Southern Tier East Regional Planning Board and New York State Department of Environmental Conservation would be instrumental in coordinating this program.

Decision-Oriented Revision.

The following issues may appear at anytime and may require plan revision.

1. Condition - Binghamton-Johnson City STP reaches capacity. Possible revisions: (a) change in-plant process; (b) expand plant size; (c) construct sub-regional facility.

2. Condition - West Owego plant reaches capacity or needs major repairs. Possible revisions: (a) expansion; (b) abandonment and connection to Owego Village.

3. Condition - Frequent violations in water quality. Possible revisions: (1) increase in treatment levels at the Binghamton-Johnson City STP.

4. Condition - New water quality standards. Possible revisions: (a) change in treatment plant logistics; (b) upgrade treatment levels.

5. Condition - Major interceptor reaches capacity. Possible revisions: (a) new treatment plant to relieve load; (b) infiltration control; (c) flow equalization and storage at pump stations or with industrial users.

Plan 2A-2

Planning activities would be the same as for Plan 2A-1, except that the Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP.

PLAN 2B

The intent of this plan was to maintain minimum instantaneous DO levels above 4 mg/l in the Susquehanna River during both low flow and storm overflow conditions. Plans 2A, 2B, and 2C are similar except for the degree of regionalization.

MUNICIPAL WASTEWATER MANAGEMENT

Regionalization of STP's

The Broome County plants would be the existing Binghamton-Johnson City and Endicott STP's and a new STP to serve the entire Chenango Valley service area. Tioga County plants would be the Town of Owego STP's No. 1 (West Owego) and No. 2 (East Owego) and the Village of Owego STP (all existing).

Service areas and interceptors included in this plan are shown in Plate 6. With the exception of the Chenango Valley sewerage system, these are the same interceptors included in the Baseline Plan.

Treatment Levels and Processes

All plants would maintain a level of treatment at least as high as is presently being attained and in no case would either the minimum secondary standards or the stream standards be contravened. The existing activated sludge processes would be used at the Binghamton-Johnson City STP and at the Town of Owego STP No. 2. A new activated sludge treatment plant would be built at Chenango. The existing trickling filter processes would be used at the Endicott STP and the Town of Owego STP No. 1. The Village of Owego STP would be upgraded to secondary treatment using a trickling filter process (recently changed to an activated sludge process).

Infiltration Control Level in the City of Binghamton

For the level of treatment (secondary) and the regionalization scheme assumed in this plan, an infiltration reduction of 1 mgd was found to be economically justifiable.

Nonstructural Measures for Flow Reduction

In this plan, the Village of Endicott and the Town of Owego would institute metered user rates. The increased price of water to the consumer should result in a reduction of water consumption, and therefore, wastewater flows.

An educational program to encourage the use of water saving devices could result in an estimated 20 percent reduction in the projected incremental increase in per capita flows. Although such a program could be undertaken, no formal education activities were specified in this plan.

STORM OVERFLOW MANAGEMENT

Microscreening units following by chlorination would be provided near five overflow sites (see Figure VII-1 in the Impact Assessment section of this Chapter). This system would maintain a minimum DO of 4 mg/l during design storm conditions. A more detailed description of the overflow treatment system is given in Chapter V and the Design and Cost Appendix. An estimate was also made of the costs of inflow control and microscreening treatment for the Village of Owego combined sewer system.

SLUDGE MANAGEMENT

Several sludge management techniques have been analyzed in Chapter V and the Design and Cost Appendix. The land application of liquid sludge was recommended, with landfill of dewatered sludge provided as a backup alternative.

CAPITAL IMPROVEMENTS PROGRAM

The Chenango Valley sewage treatment plant would be built by 1977 to conform with the Federal requirements for secondary treatment. The plant would have an initial capacity of 1.7 mgd, to be expanded to 2.2 mgd by 1985.

Expansion of the existing wastewater facilities would be required during the planning period at all STP's to handle the increasing flow expected. The construction schedule for the major components is presented in Table VII-5.

COST SUMMARY

The present worth costs for this plan are: capital - $12.6 million, O & M - $23.2 million, and replacement - $11.9 million, for a total cost of $47.7 million. The present worth costs for each service area are presented in Table VII-6.

TABLE VII-5

PLAN 2B CAPITAL IMPROVEMENTS

Service Area	New Total Capacity (mgd)	Year	Description
Binghamton-Johnson City	1.0	1977	Infiltration Control
	39.5	1977	Storm Overflow
	29.0	1977	Raw Wastewater Management
	22.0	1977	Aerator & Clarifier
	25.4	1991	Aerator & Clarifier
Endicott	0.8	1977	Nanticoke Valley Interceptor
	9.2	1983	Additional Secondary Treatment Capacity
East Owego	3.0	1992	General Expansion
West Owego	0.7	2000	General Expansion
Owego Village	1.0	1977	New Secondary Treatment Capacity
	3.0	1977	Microscreening
	-	1977	Inflow Control
Chenango Valley	1.7	1977	New Secondary Treatment Capacity
	2.2	1985	General Expansion

TABLE VII-6

PLAN 2B COSTS - PRESENT WORTH[1]
(MILLION $'s)

	Chenango Valley	Binghamton-Johnson City	Endicott	East Owego	West Owego	Owego Village	TOTAL
Wastewater Treatment							
Capital	1.7	1.1	1.3	0.5	0.1	1.0	5.7
O & M	1.5	7.3	4.4	1.9	0.4	0.7	16.2
Replacement	0.4	4.9	3.6	0.7	0.1	0.3	10.0
TOTAL	3.6	13.3	9.3	3.1	0.6	2.0	31.9
Interceptors							
Capital	-	-	1.6	-	-	-	1.6
O & M	-	-	-	-	-	-	-
Replacement	-	-	-	-	-	-	-
TOTAL	-	-	1.6	-	-	-	1.6
Storm Overflows							
Capital	-	3.6	-	-	-	1.0	4.6
O & M	-	0.8	-	-	-	0.1	0.9
Replacement	-	0.9	-	-	-	0.1	1.0
TOTAL	-	5.3	-	-	-	1.2	6.5
Infiltration Control							
Capital	-	0.2	-	-	-	-	0.2
O & M	-	-	-	-	-	-	-
Replacement	-	-	-	-	-	-	-
TOTAL	-	0.2	-	-	-	-	0.2
Sludge							
Capital	0.465	0.05	0.01	0.005	0.001	0.002	0.5
O & M	0.6	3.8	0.7	0.5	0.2	0.3	6.1
Replacement	0.1	0.3	0.2	0.1	0.1	0.1	0.9
TOTAL	1.2	4.1	0.9	0.6	0.3	0.4	7.5
Totals							
Capital	2.2	4.9	2.9	0.5	0.1	2.0	12.6
O & M	2.1	11.9	5.1	2.4	0.6	1.1	23.2
Replacement	0.5	6.1	3.8	0.8	0.2	0.5	11.9
TOTAL PLAN COST	4.8	22.9	11.8	3.7	0.9	3.6	47.7

[1]Based on a 50 year economic life @ 6 1/8% and ENR = 2248.

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Plan 2B-1: Minor Modifications to the Existing Institutions

The Binghamton-Johnson City Joint Sewage Board would continue to manage the treatment plant with the possibility of outside municipalities collectively joining the Joint Board as one member. The Broome County Sewer Agency would manage the Chenango Valley regional sewer system and treatment plant. The Towns of Fenton, Chenango, and Dickinson would manage their local collection systems.

Endicott, Union, and Owego Town should convert from flat rates and property tax to metered rates and industrial surcharges. The Broome County Sewer Agnecy should institute metered rates and user fees in Chenango Valley. All Federal grant recipients should implement industrial grant recovery and create sinking funds. Portions of grant recovery could subsidize low income families at the direction of grant recipient.

The Binghamton-Johnson Joint Sewage Board would continue with its existing cost sharing agreement with the following modifications. All debt service contributions by outside municipalities on new construction should be exempt from the 25 percent surcharge. The Towns of Maine and Union should share the Nanticoke Valley interceptor costs according to the proportion of projected flow from each.

Plan 2B-2: Expanded County District for Binghamton-Johnson City Service Area

Due to differences in institutional arrangements, Plan 2B-2 would differ from Plan 2B-1 in the following areas. The Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP rather than the Joint Sewage Board. The BCSA would also be responsible for writing standards for new sewer construction and connections.

The following would apply to the Binghamton-Johnson City service area:

1. All individual users would contribute towards all debt service, treatment and collection, O & M, and sewer rehabilitation costs.

2. New regiional collectors would be financed through separate county districts.

3. Existing and new local collection debt service would be financed by local municipalities.

The expanded Broome County Sewer District for the Binghamton-Johnson City service area and the Chenango Valley Sewer District would have separate finances, although both would be managed by the Broome County Sewer Agency.

Implementation

This plan fulfills most EPA requirements for Step 1, facilities planning (Section 201 of P.L. 92-500). The average estimated time frame to complete the remaining steps for Step 1, detailed design (Step 2), construction (Step 3), and formation of the necessary institutions would be 4 to 5 1/2 years (for either institutional arrangement) following plan selection and approval.

REVISION PROGRAM

Plan 2B-1

Five Year Revision.

The following activities should be considered five years after plan selection:

1. Revise wastewater flow projections

2. Determine effectiveness of infiltration control measures

3. Determine need for sewerage extensions

4. Assess stream standards based on water quality monitoring

5. Review performance of treatment facilities

6. Evaluate effectiveness of land application of liquid sludge.

7. Assess water quality conditions in the Chenango River. Assess impact on river use by providing: (a) additional treatment beyond secondary; (b) relocation of the Chenango STP outfall below the Route 81 River Park.

The Southern Tier East Regional Planning Board and the New York State Department of Environmental Conservation would be instrumental in coordinating this program.

Decision Oriented Revision.

The following issues may appear at any time and may require plan revision.

1. Condition - Binghamton-Johnson City STP reaches near capacity. Possible revisions: (a) change in-plant process; (b) expand plant size; (c) construct subregional facility.

2. Condition - West Owego Plant reaches capacity or needs major repairs. Possible revisions: (a) expansion; (b) abandonment and connection to Owego Village.

3. Condition - Frequent violations in water quality. Possible revisions: (a) increase in treatment levels at the Binghamton-Johnson City STP.

4. Condition - New water quality standards. Possible revisions: (a) change in plant logistics; (b) upgrade treatment level.

5. Condition - Major interceptors reach capacity. Possible revisions: (a) new treatment plant to relieve load; (b) infiltration control; (c) flow equalization and storage at pump stations or with industrial users.

6. Condition - Chenango Plant reaches capacity. Possible revision: expansion of the facility.

7. Condition - Chenango Plant operation and maintenance disproportionatly expensive. Possible revisions: (a) abandonment and connection to Binghamton-Johnson City STP; (b) changes in operating procedures.

8. Condition - Reduced water quality in the Chenango River impacting on river uses such as recreation. Possible revisions: (a) additional treatment beyond secondary; (b) relocation of Chenango STP outfall below park; (c) abandonment of STP and connection to Binghamton-Johnson City service area.

Plan 2B-2

Planning activities would be the same as for Plan 2B-1 except that the Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP.

PLAN 2C

The intent of this plan was to maintain minimum instantaneous DO levels above 4 mg/l in the Susquehanna River during both low flow and storm overflow conditions. Plans 2A, 2B, and 2C are similar except for the degree of regionalization.

MUNICIPAL WASTEWATER MANAGEMENT

Regionalization of STP's

The Broome County plants would be the existing Binghamton-Johnson City and Endicott STP's and a new STP for a phased Chenango Valley service area. The first phase of this plan would initially serve a limited Chenango Valley wastewater management area. In the second phase, the treatment plant and service area would be expanded to include the entire wastewater management area. Plan 2C is identical to Plan 2B except the scope of sewerage service for Chenango Valley would be limited to a smaller area for 5 years. Initial treatment plant capacity in 1977 would be 1.0 mgd (vs. 1.7 mgd for Plan 2B). After 1982, the entire Chenango Valley service area would be sewered and the STP expanded to 2.2 mgd.

Tioga County plants would be the Town of Owego STP's No. 1 (West Owego) and 2 (East Owego), and the Village of Owego STP (all existing).

Service areas and interceptors included in this plan are shown in Plate 6. With the exception of the Chenango Valley sewerage systems, these are the same interceptors included in the Baseline Plan. Plate 6 also details the phasing of the Chenango Valley service area.

Treatment Levels and Processes

All plants would maintain a level of treatment at least as high as is presently being attained and in no case would either the minimum secondary standards or the stream standards

be contravened. The existing activated sludge processes would be used at the Binghamton-Johnson City STP and at the Town of Owego STP No. 2. A new activated sludge treatment plant would be built in Chenango Valley. The existing trickling filter processes would be used at the Endicott STP and the Town of Owego STP No. 1. The Village of Owego STP would be upgraded to secondary treatment using a trickling filter process (recently changed to an activated sludge process).

Infiltration Control Level in the City of Binghamton

For the level of treatment (secondary) and the regionalization scheme assumed in this plan, an infiltration reduction of 1 mgd was found to be economically justifiable.

Nonstructural Measures for Flow Reduction

In this plan, the Village of Endicott and the Town of Owego would institute metered user rates. The increase in price the consumer would be paying should result in a reduction of water consumption, and therefore, wastewater flows.

An educational program to encourage the use of water saving devices could result in an estimated 20 percent reduction in the projected incremental increase in per capita flows. Although such a program could be undertaken, no formal education activities have been specified in this plan.

STORM OVERFLOW MANAGEMENT

Five microscreening units followed by chlorination would be provided near five overflow sites (see Figure VII-1 in the Impact Assessment section of this Chapter). This system would maintain a minimum DO of 4 mg/l during most storm conditions. A detailed description of the overflow treatment system is given in Chapter V and the Design and Cost Appendix. An estimate was also made of the costs of inflow control and microscreening treatment for the Village of Owego combined sewer system.

SLUDGE MANAGEMENT

Several sludge management techniques have been analyzed in Chapter V and the Design and Cost Appendix. The land application of liquid sludge is recommended, with landfill of dewatered sludge provided as a backup alternative.

CAPITAL IMPROVEMENTS PROGRAM

The Chenango Valley phased treatment plant would be built by 1977 to conform with the Federal requirements for secondary treatment by utilizing an activated sludge process. The plant would have an initial capacity of 1.0 mgd to be expanded to 2.2 mgd by 1982, with sewering extended to the entire Chenango Valley service area. Expansion of the existing wastewater facilities would be required during the planning period at all STP's to handle the increasing flow expected. The construction schedule for major components is presented in Table VII-7.

COST SUMMARY

The present worth costs for this plan are: capital - $12.6 million, O & M - $23.2 million, and replacement - $11.9 million, for a total cost of $47.7 million. The present worth costs for each service area are presented in Table VII-8.

TABLE VII-7

PLAN 2C CAPITAL IMPROVEMENTS

Service Area	New Total Capacity (mgd)	Year	Description
Binghamton-Johnson City	1.0	1977	Infiltration Control
	39.5	1977	Storm Overflow
	29.0	1977	Raw Wastewater Pumping
	22.0	1977	Aerator & Clarifier
	25.4	1991	Aerator and Clarifier
Endicott	0.8	1977	Nanticoke Valley Interceptor
	9.2	1983	Additional Secondary Treatment Capacity
East Owego	3.0	1992	General Expansion
West Owego	0.7	2000	General Expansion
Owego Village	1.0	1977	New Secondary Treatment Capability
	3.0	1977	Micro-screening
	-	1977	Inflow Control
Chenango Valley	1.0	1977	New Secondary Treatment Plant
	2.2	1982	General Expansion

TABLE VII-8

PLAN 2C COSTS – PRESENT WORTH[1]
(MILLION $'s)

	Chenango Valley	Binghamton-Johnson City	Endicott	East Owego	West Owego	Owego Village	Total
Wastewater Treatment							
Capital	1.7	1.1	1.3	0.5	0.1	1.0	5.7
O & M	1.5	7.3	4.4	1.9	0.4	0.7	16.2
Replacement	0.4	4.9	3.6	0.7	0.1	0.3	10.0
Total	3.6	13.3	9.3	3.1	0.6	2.0	31.9
Interceptors							
Capital	–	–	1.6	–	–	–	1.6
O & M	–	–	–	–	–	–	–
Replacement	–	–	–	–	–	–	–
Total	–	–	1.6	–	–	–	1.6
Storm Overflows							
Capital	–	3.6	–	–	–	1.0	4.6
O & M	–	0.8	–	–	–	0.1	0.9
Replacement	–	0.9	–	–	–	0.1	1.0
Total	–	5.3	–	–	–	1.2	6.5
Infiltration Control							
Capital	–	0.2	–	–	–	–	0.2
O & M	–	–	–	–	–	–	–
Replacement	–	–	–	–	–	–	–
Total	–	0.2	–	–	–	–	0.2
Sludge							
Capital	0.465	0.05	0.01	0.005	0.001	0.002	0.5
O & M	0.6	3.8	0.7	0.5	0.2	0.3	6.1
Replacement	0.1	0.3	0.2	0.1	0.1	0.1	0.9
Total	1.2	4.1	0.9	0.6	0.3	0.4	7.5
Totals							
Capital	2.2	4.9	2.9	0.5	0.1	2.0	12.6
O & M	2.1	11.9	5.1	2.4	0.6	1.1	23.2
Replacement	0.5	6.1	3.8	0.8	0.2	0.5	11.9
Total Plan Cost	4.8	22.9	11.8	3.7	0.9	3.6	47.7

[1] Based on a 50 year economic life @ 6-1/8% and ENR = 2248.

Plan 2C-1: Minor Modification to the Existing Institutions

The Binghamton-Johnson City Joint Sewage Board would continue to manage the treatment plant with the possibility of outside municipalities collectively joining the Board as one member. The Broome County Sewer Agency would manage the Chenango Valley regional sewer system and treatment plant. The Towns of Fenton, Chenango, and Dickinson would manage their local collection systems.

Endicott, Union, and Owego Town should convert from flat rates and property tax to metered rates and industrial surcharges. The Broome County Sewer Agency should institute metered rates and user fees in Chenango Valley. All Federal grant recipients should implement industrial grant recovery and create sinking funds. Portions of grant recovery could subsidize low income families at the discretion of the grant recipient.

The Binghamton-Johnson City Joint Sewage Board would continue with its existing cost sharing agreement with the following modifications: all debt service contributions by outside municipalities on new construction should be exempt from the 25 percent surcharge.

The Towns of Maine and Union should share the Nanticoke Valley interceptor costs according to the proportion of projected flow from each.

Plan 2C-2: Expanded County District for Binghamton-Johnson City Service Area

Due to differences in institutional arrangements, Plan 2C-2 would differ from Plan 2C-1 in the following areas. The Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP rather than the Joint Sewage Board. The BCSA would also be responsible for writing standards for new sewer construction and connections.

The following would apply to the Binghamton-Johnson City service area.

1. All individual users would contribute towards debt service, treatment and collection, O & M, and sewer rehabilitation costs.

2. New regional collectors would be financed through separate county districts.

3. Existing and new local collection debt service would be financed by local municipalities.

The expanded Broome County Sewer District for the Binghamton-Johnson City service area and the Chenango Valley Sewer District would have separate finances, although both would be managed by the Broome County Sewer Agency.

Implementation

This plan fulfills most EPA requirements for Step 1, facilities planning (Section 201 of P.L. 92-500). The average estimated time frame to complete the remaining steps for Step 1, detailed design (Step 2), and construction (Step 3) and formation of the necessary institutions would be 4 to 6 years (for either institutional arrangement) following plan selection and approval.

REVISION PROGRAM

Plan 2C-1

Five Year Revision.

The following activities should be considered 5 years after plan selection.

1. Revise wastewater flow projections

2. Determine effectiveness of infiltration control measures

3. Determine need for sewerage extensions

4. Assess stream standards based on water quality monitoring

5. Review performance of treatment facilities

6. Evaluate effectiveness of land application of liquid sludge

7. Assess water quality conditions in the Chenango River. Assess impact on river use by providing: (a) additional treatment beyond secondary; (b) relocation of the Chenango STP outfall below the Route 81 River Park.

8. Reassessment of the second phase of the Chenango Valley regional collection and treatment plant expansion needs.

The Southern Tier East Regional Planning Board and the New York State Department of Environmental Conservation would be instrumental in coordinating this program.

Decision Oriented Revision.

The following issues may appear at anytime and may require plan revision.

1. Condition - Binghamton-Johnson City STP reaches capacity. Possible revisions: (a) change in-plant process; (b) expand plant size; (c) construct subregional facility.

2. Condition - West Owego Plant reaches capacity or needs major repairs. Possible revisions: (a) expansion; (b) abandonment and connection to Owego Village.

3. Condition - Frequent violations of water quality. Possible revisions: (a) upgrade treatment levels at the Binghamton-Johnson City STP.

4. Condition - New water quality standards. Possible revisions: (a) change in treatment plant logistics; (b) change in treatment levels.

5. Condition - Major interceptors reach capacity. Possible revisions: (a) new treatment plant to relieve load; (b) infiltration control; (c) flow equalization and storage at pump stations or with industrial users.

6. Condition - Chenango Plant reaches capacity. Possible revision: expansion of the facility.

7. Condition - Chenango Plant operation and maintenance disproportionately expensive. Possible revisions: (a) abandonment; (b) changes in operating procedures.

8. Condition - Reduced water quality in the Chenango River impacting in river uses such as recreation. Possible revisions: (a) upgrade treatment levels; (b) relocate Chenango STP outfall below Route 81 River Park; (c) abandonment of STP and connection to Binghamton-Johnson City service area.

9. Condition - Dangerous public health condition resulting from withholding sewer service in Chenango Valley. Possible revisions: (a) sewerage extensions and plant expansion.

Plan 2C-2

Planning activities would be the same as for Plan 2C-1 except that the Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP.

PLAN 3A

The intent of this plan was to maintain minimum daily average DO levels above 5 mg/l in the Susquehanna River during low flow conditons and minimum instantaneous levels above 4 mg/l during design storm conditions. Plans 3A, 3B, and 3C are similar except for the degree of regionalization.

MUNICIPAL WASTEWATER MANAGEMENT

Regionalization of STP's

The Broome County plants would be at the existing Binghamton-Johnson City and Endicott STP's. The wastewater generated from the entire Chenango Valley service area would be treated at the Binghamton-Johnson City STP. Tioga County plants would be at the Town of Owego STP's No. 1 (West Owego) and No. 2 (East Owego) and the Village of Owego STP.

Service areas and interceptors included in this plan are shown in Plate 5. The only additional interceptor to those included in the 1977 Baseline Plan would connect the Chenango Valley service area to the north end of the City of Binghamton wastewater collection system.

Treatment Levels and Processes

Nitrification facilities would be added to the existing activated sludge secondary treatment process at the Binghamton-Johnson City STP by 1994. All other plants would maintain a level of treatment at least as high as is presently being attained and in no case would either the minimum secondary standards or the stream standards be contravened. The Owego Village treatment plant would be upgraded to provide secondary treatment using a trickling filter process (recently changed to an activated sludge process). The activated sludge process at the Town of Owego STP No. 2 and the trickling filter processes at the Village of Endicott and

the Town of Owego STP No. 1 would be continued in use with their capacities expanded as the wastewater flow increases.

Infiltration Control Level in the City of Binghamton

For the level of treatment (secondary + nitrification) and the regionalization scheme assumed in this plan, an infiltration flow reduction of 3 mgd was found to be economically justifiable.

Nonstructural Measures for Flow Reduction

In this plan, the Village of Endicott and the Town of Owego would institute metered user rates. The increase in price the consumer would be paying should result in a reduction of water consumption, and therefore, wastewater flows.

An educational program to encourage the use of water saving devices could result in an estimated 20 percent reduction in the projected incremental increase in per capita flows. Although such a program could be undertaken, no formal educational activities have been specified in this plan.

STORM OVERFLOW MANAGEMENT

Microscreening units followed by chlorination would be provided near five overflow sites (see Figure VII-1 in Impact Assessment section later in this Chapter). This system would maintain a minimum DO of 4 mg/l during most storm conditions. A detailed description of the overflow treatment systems is given in Chapter V and the Design and Cost Appendix. An estimate was also made of the costs of inflow control and microscreening treatment for the Village of Owego combined sewer system.

SLUDGE MANAGEMENT

Several sludge management techniques have been analyzed in Chapter V and the Design and Cost Appendix. The land application of liquid sludge is recommended, with landfill of dewatered sludge as a backup alternative.

CAPITAL IMPROVEMENTS PROGRAM

Expansion of the existing wastewater facilities would be required during the planning period to handle the increasing flow expected. The construction schedule for these expansions, the required interceptors, nitrification units, stormwater control facilities, and infiltration control, is presented in Table VII-9.

COST SUMMARY

The present worth costs for this plan are: capital - $15.8 million, O & M - $22.9 million, and replacement - $11.8 million, for a total cost of $50.5 million. The present worth costs for each service area are presented in Table VII-10.

TABLE VII-9

PLAN 3A CAPITAL IMPROVEMENTS

Service Area	New Total Capacity (mgd)	Year	Description
Binghamton-Johnson City	2.2	1977	Chenango Interceptor
	3.0	1977	Infiltration Control
	39.5	1977	Storm Overflow
	29.0	1977	Raw Wastewater Pumping
	27.0	1977	Aerator and Clarifier
	24.4	1994	Nitrification
Endicott	0.8	1977	Nanticoke Valley Interceptor
	9.2	1983	Additional Secondary Treatment Capacity
East Owego	3.0	1992	General Expansion
West Owego	0.7	2000	General Expansion
Owego Village	1.0	1977	New Secondary Treatment Capability
	3.0	1977	Micro-screening
		1977	Inflow Control

TABLE VII-10

PLAN 3A COSTS - PRESENT WORTH[1]
(MILLION $'s)

	Binghamton-Johnson City	Endicott	East Owego	West Owego	Owego Village	TOTAL
Wastewater Treatment						
Capital	2.9	1.3	0.5	0.1	1.0	5.8
O & M	8.6	4.4	1.9	0.4	0.7	16.0
Replacement	5.3	3.6	0.7	0.1	0.3	10.0
TOTAL	16.8	9.3	3.1	0.6	2.0	31.8
Interceptors						
Capital	2.5	1.6	-	-	-	4.1
O & M	-	-	-	-	-	-
Replacement	-	-	-	-	-	-
TOTAL	2.5	1.6	-	-	-	4.1
Storm Overflows						
Capital	3.6	-	-	-	1.0	4.6
O & M	0.8	-	-	-	0.1	0.9
Replacement	0.9	-	-	-	0.1	1.0
TOTAL	5.3	-	-	-	1.2	6.5
Infiltration Control						
Capital	1.2	-	-	-	-	1.2
O & M	-	-	-	-	-	-
Replacement	-	-	-	-	-	-
TOTAL	1.2	-	-	-	-	1.2
Sludge						
Capital	0.05	0.01	0.005	0.001	0.002	0.1
O & M	4.3	0.7	0.5	0.2	0.3	6.0
Replacement	0.3	0.2	0.1	0.1	0.1	0.8
TOTAL	4.7	0.9	0.6	0.3	0.4	6.9
Totals						
Capital	10.3	2.9	0.5	0.1	2.0	15.8
O & M	13.7	5.1	2.4	0.6	1.1	22.9
Replacement	6.5	3.8	0.8	0.2	0.5	11.8
TOTAL PLAN COST	30.5	11.8	3.7	0.9	3.6	50.5

[1]Based on a 50 year economic life @ 6 1/8% and ENR = 2248

INSTITUTIONAL ARRANGEMENTS

The only additional requirement to maintain 5 mg/l DO in the Susquehanna River (Plan 3) over the 4 mg/l system (Plan 2) is the provision of nitrification facilities for ammonia removal at the Binghamton-Johnson City STP during the 1990's. Other than the modifications in capital improvements and manpower requirements (see Institutional Analysis Appendix), the detailed refinement of Plan 3A-2 is virtually identical to Plan 2A-1 (likewise for Plans 3A-2 and 2A-2). The institutions and the implementation programs to create them are the same for both plans. Since the desired stream quality is different, however, the revisions program would be slightly modified to reflect this change.

MANAGEMENT AND IMPLEMENTATION PROGRAM

Plan 3A-1: Minor Modifications to Existing Institutions

The Broome County Sewer Agency would manage the Chenango Valley regional collection system and act as intermediary between the Binghamton-Johnson City Joint Sewage Board (BJCJSB) and Fenton, Chenango, and Dickinson users. The Joint Sewage Board would continue to manage the treatment plant.

Endicott, Union, and Owego Town should convert from flat rates and property tax to metered rates and industrial surcharges. The Broome County Sewer Agency should institute metered rates and user fees in Chenango Valley. All Federal grant recipients should implement industrial grant recovery and create sinking funds. Portions of grant recovery could subsidize low income families at the discretion of the grant recipient.

The BJCJSB would continue with the existing cost sharing agreement with the following modifications:

1. The Broome County Sewer Agency should finance in 1977 the portion of the new construction at the Binghamton plant attributable to Chenango Valley (one set of aeration and clarifier units).

2. All debt service contributions by outside municipalities on new construction should be exempt from the 25 percent surcharge.

The Towns of Maine and Union should share the Nanticoke Valley interceptor costs according to the projected flow from each.

Plan 3A-2: Expanded County District for Binghamton-Johnson City Service Area

Due to differences in institutional arrangements, Plan 3A-2 would differ from Plan 3A-1 in the following areas. The Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City plant rather than the Joint Sewage Board. The BCSA would also be responsible for writing standards for new sewer construction and connections.

The Binghamton-Johnson City service area would do the following:

1. All individual users would contribute towards all debt service, treatment and collection, O & M, and sewer rehabilitation costs.

2. New regional collectors would be financed through separate county districts.

3. Existing and new local collection debt services would be financed by local municipalities.

Implementation

This plan fulfills most EPA requirements for Step 1, facilities planning (Section 201 of P.L. 92-500). The average estimated time frame to complete the remaining steps for Step 1, detailed design (Step 2), construction (Step 3), and formation of the necessary institutions would be 3 1/2 to 5 years for Plan 3A-1 and 3 to 6 1/2 years for Plan 3A-2, following plan selection and approval.

REVISION PROGRAM

Plan 3A-1

Five Year Revision.

The following activities should be considered 5 years after plan selection.

1. Revise wastewater flow projections

2. Determine effectiveness of infiltration control measures

3. Determine need for sewerage extensions

4. Assess stream standards based on water quality monitoring

5. Review performance of treatment facilities

6. Evaluate effectiveness of land application of liquid sludge.

The Southern Tier East Regional Planning Board and the New York State Department of Environmental Conservation would be instrumental in coordinating this program.

Decision Oriented Revision.

The following issues may appear at anytime and may require plan revision.

1. Condition - Binghamton-Johnson City STP reaches capacity. Possible revisions: (a) change in-plant process; (b) expand plant size; (c) construct subregional facility.

2. Condition - West Owego plant reaches capacity or needs major repairs. Possible revisions: (a) expansion; (b) abandonment and connection to Owego Village.

3. Condition - Frequent violations in water quality. Possible revisions: (a) increase in treatment levels at the Binghamton-Johnson City STP such as updating the construction of nitrification facilities.

4. Condition - New water quality standards. Possible revisions: (a) change in treatment plant logistics; (b) upgrade treatment levels.

5. Condition - Major interceptors reach capacity. Possible revisions: (a) new treatment plant to relieve load; (b) infiltration control; (c) flow equalization and storage at pump stations or with industrial users.

Plan 3A-2

Planning activities would be the same as for Plan 3A-1 except the Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP.

PLAN 3B

The intent of this plan was to maintain minimum daily average DO levels above 5 mg/l in the Susquehanna River during low flow conditions and minimum instantaneous levels above 4 mg/l during storm overflow conditions. Plans 3A, 3B, and 3C are similar except for the degree of regionalization.

MUNICIPAL WASTEWATER MANAGEMENT

Regionalization of STP's

The Broome County plants would be the existing Binghamton-Johnson City and Endicott STP's and a new STP to serve the entire Chenango Valley service area. Tioga County plants would be the Town of Owego STP's No. 1 (West Owego) and No. 2 (East Owego), and the Village of Owego STP (all existing).

Service areas and interceptors included in this plan are shown in Plate 6. With the exception of the Chenango Valley sewerage system, these are the same interceptors included in the Baseline Plan.

Treatment Levels and Processes

Nitrification facilities would be added by 1994 to the existing activated sludge secondary treatment process at the Binghamton-Johnson City STP. All other plants would maintain a level of treatment at least as high as is presently being attained and in no case would either the minimum secondary standards or the stream standards be contravened. The new Chenango Valley STP would use an activated sludge process. The Owego Village treatment plant would be upgraded to provide secondary treatment using a trickling filter process (recently changed to an activated sludge process). The activated sludge process at the Town of Owego STP No. 2 and the trickling filter processes at the Village of Endicott

and the Town of Owego STP No. 1 would be continued in use with their capacities upgraded as the wastewater flow increases.

Infiltration Control Level in the City of Binghamton

For the level of treatment (secondary plus nitrification) and the regionalization scheme assumed in this plan, an infiltration flow reduction of 3 mgd was found to be economically justifiable.

Nonstructural Measures for Flow Reduction

In this plan, the Village of Endicott and the Town of Owego would institute metered user rates. The increase in price the consumer would be paying should result in a reduction of water consumption, and therefore, wastewater flows.

An educational program to encourage the use of water saving devices could result in an estimated 20 percent reduction in the projected incremental increase in per capita flows. Although such a program could be undertaken, no formal education activities have been specified in this plan.

STORM OVERFLOW MANAGEMENT

Microscreening devices followed by chlorination would be provided near five overflow sites (see Figure VII-1 in the Impact Assessment section later in this Chapter). This would maintain a minimum DO of 4 mg/l during design storm conditions. A detailed description of the overflow treatment system is given in Chapter V and the Design and Cost Appendix. An estimate was also made of the cost of inflow control and microscreening treatment for the Village of Owego combined sewer system.

SLUDGE MANAGEMENT

Several sludge management techniques have been analyzed in Chapter V and the Design and Cost Appendix. The land application of liquid sludge is recommended with landfill of dewatered sludge provided as a backup alternative.

CAPITAL IMPROVEMENTS

The Chenango Valley sewage treatment plant would be built by 1977 to conform with the Federal requirements for secondary treatment. The plant would have an initial capacity of 1.7 mgd, to be expanded to 2.2 mgd by 1985.

Expansion of the existing wastewater facilities would be required during the planning period at all STP's to handle the increasing flow expected. The construction schedule for major components is presented in Table VII-11.

COST SUMMARY

The present worth costs for this plan are: capital - $14.8 million, O & M - $24.1 million, and replacement - $12.2 million, for a total cost of $51.1 million. The present worth costs for each service area are presented in Table VII-12.

INSTITUTIONAL ARRANGEMENTS

The only additional requirement to maintain 5 mg/l DO in the Susquehanna River (Plan 3) over the 4 mg/l system (Plan 2) is the provision of nitrification facilities for ammonia removal at the Binghamton-Johnson City STP during the 1990's. Other than the modifications in capital improvements

TABLE VII-11

PLAN 3B CAPITAL IMPROVEMENTS

Service Area	New Total Capacity (mgd)	Year	Description
Binghamton-Johnson City	3.0	1977	Infiltration Control
	39.5	1977	Storm Overflow
	29.0	1977	Raw Wastewater Pumping
	21.5	1977	Aerator and Clarifier
	22.3	1994	Nitrification
	24.5	2000	Aerator and Clarifier
Endicott	0.8	1977	Nanticoke Valley Interceptor
	9.2	1983	Additional Secondary Treatment
East Owego	3.0	1992	General Expansion
West Owego	0.7	2000	General Expansion
Owego Village	1.0	1977	New Secondary Treatment Capacity
	3.0	1977	Microscreening
	-	1977	Inflow Control
Chenango Valley	1.7	1977	New Secondary Treatment Plant
	2.2	1985	General Expansion

TABLE VII-12

PLAN 3B COSTS - PRESENT WORTH[1]

	Chenango Valley	Binghamton-Johnson City	Endicott	East Owego	West Owego	Owego Village	TOTAL
Wastewater Treatment							
Capital	1.7	2.3	1.3	0.5	0.1	1.0	6.9
O & M	1.5	8.2	4.4	1.9	0.4	0.7	17.1
Replacement	0.4	5.2	3.6	0.7	0.1	0.3	10.3
TOTAL	3.6	15.7	9.3	3.1	0.6	2.0	34.3
Interceptors							
Capital	-	-	1.6	-	-	-	1.6
O & M	-	-	-	-	-	-	-
Replacement	-	-	-	-	-	-	-
TOTAL	-	-	1.6	-	-	-	1.6
Storm Overflows							
Capital	-	3.6	-	-	-	1.0	4.6
O & M	-	0.8	-	-	-	0.1	0.9
Replacement	-	0.9	-	-	-	0.1	1.0
TOTAL	-	5.3	-	-	-	1.2	6.5
Infiltration Control							
Capital	-	1.2	-	-	-	-	1.2
O & M	-	-	-	-	-	-	-
Replacement	-	-	-	-	-	-	-
TOTAL	-	1.2	-	-	-	-	1.2
Sludge							
Capital	0.465	0.05	0.01	0.005	0.001	0.002	0.5
O & M	0.6	3.8	0.7	0.5	0.2	0.3	6.1
Replacement	0.1	0.3	0.2	0.1	0.1	0.1	0.9
TOTAL	1.2	4.1	0.9	0.6	0.3	0.4	7.5
Totals							
Capital	2.2	7.1	2.9	0.5	0.1	2.0	14.8
O & M	2.1	12.8	5.1	2.4	0.6	1.1	24.1
Replacement	0.5	6.4	3.8	0.8	0.2	0.5	12.2
TOTAL PLAN COST	4.8	26.3	11.8	3.7	0.9	3.6	51.1

[1]Based on a 50 year economic life @ 6 1/8% and ENR = 2248

and manpower requirements (see Institutional Analysis Appendix), the detailed refinement of Plan 3B-1 is virtually identical to Plan 2B-1 (likewise for Plan 3B-2 and 2B-2). The institutions and the implementation programs to create these are the same for both plans. Since the desired stream quality is different, however, the revisions program would be slightly modified to reflect this change.

MANAGEMENT AND IMPLEMENTATION PROGRAM

Plan 3B-1: Minor Modification to the Existing Institutions

The Binghamton-Johnson City Joint Sewage Board would continue to manage the treatment plant with the possibility of outside municipalities collectively joining the Joint Board as one member. The Broome County Sewer Agency would manage the Chenango Valley regional sewer system and treatment plant. The Towns of Fenton, Chenango, and Dickinson would manage their local collection systems.

Endicott, Union, and Owego Town should convert from flat rates and property tax to metered rates and industrial surcharges. The Broome County Sewer Agency should institute metered rates and user fees in Chenango Valley. All Federal grant recipients should implement industrial grant recovery and create sinking funds. Portions of grant recovery could subsidize low income families at the discretion of the grant recipient.

The Binghamton-Johnson City Joint Sewage Board would continue with its existing cost-sharing agreement with the following modifications. All debt service contributions by outside municipalities on new construction should be exempt from the 25 percent surcharge. The Towns of Maine and Union should share the Nanticoke Valley interceptor costs according to the proportion of projected flow from each.

Plan 3B-2: Expanded County District for Binghamton-Johnson City Service Area

Due to differences in institutional arrangements, Plan 3B-2 would differ from Plan 3B-1 in the following areas. The Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP rather than the Joint Sewage Board. The BCSA would also be responsible for writing standards for new sewer construction and connections.

The following would apply to the Binghamton-Johnson City service area.

1. All individual users would contribute towards all debt service, treatment and collection, O & M, and sewer rehabilitation costs.

2. New regional collectors would be financed through separate county districts.

3. Existing and new local collection debt service would be financed by local municipalities.

The expanded Broome County Sewer District for the Binghamton-Johnson City service area and the Chenango Valley Sewer District would have separate finances, although both would be managed by the Broome County Sewer Agency.

Implementation

This plan fulfills most EPA requirements for Step 1, facilities planning (Section 201 of P.L. 92-500). The estimated time frame to complete the remaining steps for Step 1, detailed design (Step 2), construction (Step 3), and formation of the necessary institutions would be 4 to 5 1/2 years following plan selection and approval.

REVISION PROGRAM

Plan 3B-1

Five Year Revision.

The following activities should be considered 5 years after plan selection:

1. Revise wastewater flow projections

2. Determine effectiveness of infiltration control measures

3. Determine need for sewerage extensions

4. Assess stream standards based on water quality monitoring

5. Review performance of treatment facilities

6. Evaluate effectiveness of land application of liquid sludge

7. Assess water quality conditions in the Chenango River. Assess impact on river use by providing: (a) additional treatment beyond secondary; (b) relocation of the Chenango STP outfall below the Route 81 River Park.

The Southern Tier East Regional Planning Board and the New York State Department of Environmental Conservation would be instrumental in coordinating this program.

Decision Oriented Revision.

The following issues may appear at any time and may require plan revision.

1. Condition - Binghamton-Johnson City STP reaches near capacity. Possible revisions: (a) change in-plant process; (b) expand plant size; (c) construct subregional facility.

2. Condition - West Owego plant reaches capacity or needs major repairs. Possible revisions: (a) expansion; (b) abandonment and connection to Owego Village.

3. Condition - Frequent violations of water quality standards. Possible revision: increase intreatment levels at the Binghamton-Johnson City STP such as updating the construction of nitrification facilities.

4. Condition - New water quality standards. Possible revisions: (a) change in plant logistics; (b) upgrade treatment level.

5. Condition - Major interceptors reach capacity. Possible revisions: (a) new treatment plant to relieve load; (b) infiltration control; (c) flow equalization and storage at pump stations or with industrial users.

6. Condition - Chenango Plant reaches capacity. Possible revision: expansion of the facility.

7. Condition - Chenango Plant operation and maintenance disproportionately expensive. Possible revisions: (a) abandonment and connection to Binghamton-Johnson City STP; (b) changes in operating procedures.

8. Condition - Reduced water quality in the Chenango River impacting on river uses such as recreation. Possible revisions: (a) additional treatment beyond secondary; (b) relocation of Chenango STP outfall below park; (c) abandonment of STP and connection to Binghamton-Johnson City service area.

Plan 3B-2

Planning activities would be the same as for Plan 3B-1 except that the Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP.

PLAN 3C

The intent of this plan was to maintain minimum daily average DO levels above 5 mg/l in the Susquehanna River during low flow conditions and minimum instantaneous levels above 4 mg/l during storm overflow conditions. Plans 3A, 3B, and 3C are similar except for the degree of regionalization.

MUNICIPAL WASTEWATER MANAGEMENT

Regionalization of STP's

The Broome County plants would be the existing Binghamton-Johnson City and Endicott STP's and a new STP for a limited Chenango Valley service area. The first phase of this Plan would serve a limited Chenango Valley wastewater management area. In the final phase, the treatment plant and service area would be expanded to include the entire wastewater management area.

Plan 3C is identical to Plan 3B except that the scope of sewerage service for Chenango Valley would be limited to a smaller area for five years. Initial treatment plant capacity in 1977 would be 1.0 mgd (vs. 1.7 mgd for Plan 2B). After 1982, the entire Chenango Valley service area would be sewered and the STP expanded to 2.2 mgd. Tioga County plants would be the Town of Owego STP's No. 1 (West Owego) and No. 2 (East Owego) and the Village of Owego STP (all existing).

Service area and interceptors in this plan are shown in Plate 6. With the exception of the Chenango Valley sewerage system, these are the same interceptors included in the Baseline Plan. Plate 6 also details the phasing of the Chenango Valley service area.

Treatment Levels and Processes

Nitrification facilities would be added to the existing activated sludge secondary treatment process at the Binghamton-Johnson City STP by 1994. All other plants would maintain a level of treatment at least as high as is presently being attained and in no case would either the minimum secondary standards or the stream standards be contravened. The new Chenango Valley STP would use an activated sludge process. The Owego Village treatment plant would be upgraded to provide secondary treatment using a trickling filter process (recently revised to an activated sludge process). The activated sludge process at the Town of Owego STP No. 2 and the trickling filter processes at the Village of Endicott and the Town of Owego STP No. 1 would continue in use with their capacities upgraded as the wastewater flow increases.

Infiltration Control Level in the City of Binghamton

For the level of treatment (secondary plus nitrification) and the regionalization scheme assumed in this plan, an infiltration reduction of 3 mgd was found economically justifiable.

Nonstructural Measures for Flow Reduction

In this plan, the Village of Endicott and the Town of Owego would institute metered user rates. The increase in price the consumer would be paying should result in a reduction of water consumption, and therefore, wastewater flows.

An educational program to encourage the use of water saving devices could result in an estimated 20 percent reduction in the projected incremental increase in per capita flows. Although such a program could be undertaken, no formal educational activities have been specified in this plan.

STORM OVERFLOW MANAGEMENT

Microscreening units followed by chlorination would be provided near five overflow sites (see Figure VII-1 in the Impact Assessment section later in this Chapter). This system would maintain a minimum DO of 4 mg/l during most storm conditions. A detailed description is given in Chapter V and the Design and Cost Appendix. An estimate was also made of the costs of inflow control and microscreening treatment for the Village of Owego combined sewer system.

SLUDGE MANAGEMENT

Several sludge management techniques have been analyzed in Chapter V and the Design and Cost Appendix. The land application of liquid sludge is recommended, with landfill of dewatered sludge provided as a backup alternative.

CAPITAL IMPROVEMENTS

The Chenango Valley phased treatment plant would be built by 1977 to conform with the Federal requirements for secondary treatment by utilizing an activated sludge process. The plant would have an initial capacity of 1.0 mgd to be expanded to 2.2 mgd by 1982, with sewering extended to the entire Chenango Valley service area.

Expansion of the existing wastewater facilities would be required during the planning period to handle the increase in projected flows. The construction schedule for major components is shown in Table VII-13.

TABLE VII-13

PLAN 3C CAPITAL IMPROVEMENTS

Service Area	New Total Capacity (mgd)	Year	Description
Binghamton-Johnson City	3.0	1977	Infiltration Control
	39.5	1977	Storm Overflow
	29.0	1977	Raw Wastewater Pumping
	21.5	1977	Aerator and Clarifier
	22.3	1994	Nitrification
	24.5	2000	Aerator and Clarifier
Endicott	0.8	1977	Nanticoke Valley Interceptor
	9.2	1983	Additional Secondary Treatment Capacity
East Owego	3.0	1992	General Expansion
West Owego	0.7	2000	General Expansion
Owego Village	1.0	1977	New Secondary Treatment Capacity
	3.0	1977	Micro-screening
	-	1977	Inflow Control
Chenango Valley	1.0	1977	New Secondary Treatment Plant
	2.2	1985	General Expansion

COST SUMMARY

The present worth costs for this plan are: capital - $14.8 million, O & M - $24.1 million, and replacement - $12.2 million, for a total cost of $51.1 million. The present worth costs for each service area are presented in Table VII-14.

TABLE VII-14

PLAN 3C - PRESENT WORTH[1] (MILLION $'s)

	Chenango Valley	Binghamton-Johnson City	Endicott	East Owego	West Owego	Owego Village	TOTAL
Wastewater Treatment							
Capital	1.7	2.3	1.3	0.5	0.1	1.0	6.9
O & M	1.5	8.2	4.4	1.9	0.4	0.7	17.1
Replacement	0.4	5.2	3.6	0.7	0.1	0.3	10.3
TOTAL	3.6	15.7	9.3	3.1	0.6	2.0	34.3
Interceptors							
Capital	-	-	1.6	-	-	-	1.6
O & M	-	-	-	-	-	-	-
Replacement	-	-	-	-	-	-	-
TOTAL	-	-	1.6	-	-	-	1.6
Storm Overflow							
Capital	-	3.6	-	-	-	1.0	4.6
O & M	-	0.8	-	-	-	0.1	0.9
Replacement	-	0.9	-	-	-	0.1	1.0
TOTAL	-	5.3	-	-	-	1.2	6.5
Infiltration Control							
Capital	-	1.2	-	-	-	-	1.2
O & M	-	-	-	-	-	-	-
Replacement	-	-	-	-	-	-	-
TOTAL	-	1.2	-	-	-	-	1.2
Sludge							
Capital	0.465	0.05	0.01	0.005	0.001	0.002	0.5
O & M	0.6	3.8	0.7	0.5	0.2	0.3	6.1
Replacement	0.1	0.3	0.2	0.1	0.1	0.1	0.9
TOTAL	1.2	4.1	0.9	0.6	0.3	0.4	7.5
Totals							
Capital	2.2	7.1	2.9	0.5	0.1	2.0	14.8
O & M	2.1	12.8	5.1	2.4	0.6	1.1	24.1
Replacement	0.5	6.4	3.8	0.8	0.2	0.5	12.2
TOTAL	4.8	26.3	11.8	3.7	0.9	3.6	51.1

[1]Based on a 50 year economic life @ 6 1/8% and ENR = 2248

INSTITUTIONAL ARRANGEMENTS

The only additional requirement to maintain 5 mg/l DO in the Susquehanna River (Plan 3) over the 4 mg/l system (Plan 2) is the provision of nitrification facilities for ammonia removal at the Binghamton-Johnson City STP during the 1990's. Other than the modification in capital improvements and manpower requirements (see Institutional Analysis Appendix), the detailed refinement of Plan 3C-1 in virtually identical to Plan 2C-1 (likewise for Plans 3C-2 and 2C-2). The institutions and the implementation programs to create them are the same for both plans. Since the desired stream quality is different, however, the revisions program would be slightly modified to reflect this change.

MANAGEMENT AND IMPLEMENTATION PROGRAM

Plan 3C-1: Minor Modifications to the Existing Institutions

The Binghamton-Johnson City Joint Sewage Board would continue to manage the treatment plant with the possibility of outside municipalities collectively joining the Board as one member. The Towns of Fenton, Chenango, and Dickinson would manage their local collection systems.

Endicott, Union, and Owego should convert from flat rates and property tax to metered rates and industrial surcharges. The Broome County Sewer Agency should institute metered rates and user fees in Chenango Valley. All Federal grant recipients should implement industrial grant recovery and create sinking funds. Portions of grant recovery could subsidize low income families at the discretion of the grant recipient.

The Binghamton-Johnson City Joint Sewage Board would continue with its existing cost sharing agreement with the following modifications: all debt service contributions by outside municipalities on new construction should be exempt from the 25 percent surcharge. The Towns of Maine and Union should share the Nanticoke Valley interceptor costs according to the proportion of projected flow from each.

Plan 3C-2: Expanded County District for Binghamton-Johnson City Service Area

Due to differences in institutional arrangements, Plan 3C-2 would differ from Plan 3C-1 in the following areas. The Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP rather than the Joint Sewage Board. The BCSA would also be responsible for writing standards for new sewer construction and connections.

The following would apply to the Binghamton-Johnson City service area:

1. All individual users would contribute towards debt service, treatment and collection, O & M, and sewer rehabilitation costs.

2. New regional collectors would be financed through separate county districts.

3. Existing and new local collection debt service would be financed by local municipalities.

The expanded Broome County Sewer District for the Binghamton-Johnson City service area and the Chenango Valley Sewer Distrit ould have separate finances, although both would be managed bythe Broome County Sewer Agency.

Implementation

This plan fulfills most EPA requirements for Step 1, facilities planning (Section 201 of P.L. 92-500). The estimated time frame to complete the remaining steps for Step 1, detailed design (Step 2), construction (Step 3), and formation of the necessary institutions would be 4 to 6 years (for either institutional arrangement) following plan selection and approval.

REVISION PROGRAM

Plan 3C-1

Five Year Revision.

The following activities should be considered five years after plan selection:

1. Revise wastewater flow projections

2. Determine effectiveness of infiltration control measures

3. Determine need for sewerage extensions

4. Assess stream standards based on water quality monitoring

5. Review performance of treatment facilities

6. Evaluate effectiveness of land application of liquid sludge

7. Assess water quality conditions in the Chenango River. Assess impact on river use by providing: (a) additional treatment beyond secondary; and (b) relocation of the Chenango Valley STP outfall below the Route 81 River Park.

8. Reassessment of the second phase of the Chenango Valley regional collection and treatment plant expansion needs.

The Southern Tier East Regional Planning Board and the New York State Department of Environmental Conservation would be instrumental in coordinating this program.

Decision Oriented Revision.

The following issues may appear at any time and may require plan revision.

1. Condition - Binghamton-Johnson STP reaches capacity. Possible revisions: (a) change in-plant process; (b) expand plant size; (c) construct subregional facility.

2. Condition - West Owego Plant reaches capacity or needs major repairs. Possible revisions: (a) expansion; (b) abandonment and connection to Owego Village.

3. Condition - Frequent violations of water quality. Possible revisions: (a) upgrade treatment levels at the Binghamton-Johnson City STP such as updating construction of nitrification facilities.

4. Condition - New water quality standards. Possible revisions: (a) change in treatment plant logistics; (b) change in treatment levels.

5. Condition - Major interceptors reach capacity. Possible revisions: (a) new treatment plant to relieve load; (b) infiltration control; (c) flow equalization and storage at pump stations or with industrial users.

6. Condition - Chenango Plant reaches capacity. Possible revisions: (a) expansion of the facility.

7. Condition - Chenango Plant operation and maintenance disproportionately expensive. Possible revisions: (a) abandonment; (b) changes in operating procedures.

8. Condition - Reduced water quality in the Chenango River impacting on river uses such as recreation. Possible revisions: (a) upgrade treatment levels; (b) relocate Chenango STP outfall below Route 81 River Park; (c) abandonment of STP and connection to Binghamton-Johnson City service area.

9. Condition - Dangerous public health condition resulting from withholding sewer service in Chenango Valley. Possible revision: sewerage extensions and plant expansion.

Plan 3C-2

Planning activities would be the same as for Plan 3C-1 except that the Broome County Sewer Agency would be responsible for managing the Binghamton-Johnson City STP.

PLAN 4

This plan provides for the application of Best Practicable Waste Treatment Technology (BPWTT) by the year 1983 and Advanced Waste Treatment Technology (AWT) by the year 1985 at all municipal wastewater treatment plants to achieve the Corps of Engineers' definition of zero discharge and to maintain DO levels above 6 mg/l during low flow conditions. Storm overflow management facilities would be provided to maintain a minimum instantaneous DO above of 5.0 mg/l in the Susquehanna River during storm overflow conditions.

MUNICIPAL WASTEWATER MANAGEMENT

Regionalization of STP's

The Broome County plants would be the existing Binghamton-Johnson City and Endicott STP's. Tioga County STP's would be the Town of Owego STP No. 1 (West Owego) and No. 2 (East Owego). The selection of this regionalization scheme was based on the economies of scale of AWT systems.

Service areas and regional interceptors included in this plan are shown in Plate 4. A regional interceptor would transmit Chenango Valley wastewater to be treated at the Binghamton-Johnson STP. Another regional interceptor would carry wastewater from the Village of Owego for treatment at the Town of Owego STP No. 1.

Treatment Levels and Processes

The same treatment levels would be applied at all the STP's. By 1983, BPWTT would provide nitrification of secondary effluent while AWT (1985) would provide denitrification, phophorus removal, filtration, and carbon adsorption processes. A detailed description of the treatment processes is given in the Design and Cost Appendix.

Infiltration Control Level in the City of Binghamton

For the advanced waste treatment level and the regionalization scheme assumed in this alternative, an infiltration flow reduction of 3 mgd was found economically justifiable.

Nonstructural Measures for Flow Reduction

In this plan, the Village of Endicott and the Town of Owego would institute metered user rates. The increased price of water to the consumer should result in no increase in current per capita water consumption (and, therefore, per capita wastewater flows) in any of the service areas.

An educational program to encourage the use of water saving devices could result in sufficient reduction to maintain wastewater flows at their current per capita rate. Formal educational activities are detailed in the Speciality Appendix. This program would have the following major features:

1. Orient the program toward residences;

2. Stress the dollar savings of reduced water, sewer, and water heating bills to individual users by installing water saving devices;

3. Differentiate between homeowners, renters, and landlords;

4. Disseminate information by mail once a year;

5. Operate for 10-15 years;

6. Coordinate with local hardware suppliers to ensure the availability of water saving devices;

7. Promote local building code amendments with maximum water use specifications.

STORM OVERFLOW MANAGEMENT

Microscreening units followed by chlorination would be provided near five overflow sites (see Figure VII-1 in the Impact Assessment section of this Chapter). This system, together with advanced wastewater treatment, would maintain a minimum DO of 5 mg/l during design storm conditions. A detailed description of the overflow treatment system is given in Chapter V and the Design and Cost Appendix. An estimate was also made of the cost of inflow control and microscreening treatment for the Village of Owego sewer system.

SLUDGE MANAGEMENT

Several sludge management techniques have been analyzed in Chapter V and in the Design and Cost Appendix. The land application of liquid sludge is recommended with landfill of dewatered sludge provided as a backup alternative.

CAPITAL IMPROVEMENTS PROGRAM

Nitrification units would be added to all STP's by 1983. The AWT processes would be added by 1985 to approach the Federal goal of zero discharge of pollutants. Expansion of facilities would also be required during the planning period to handle the projected increase in flows. The construction schedule for major components is shown in Table VII-15.

COST SUMMARY

The present worth costs for this plan are: capital - $27.5 million, O & M - $48.4 million, and replacement - $14.3 million, for a total cost of $90.2 million. The present worth costs for each service area are presented in Table VII-16.

TABLE VII-15

PLAN 4 CAPITAL IMPROVEMENTS

Service Area	New Total Capacity (mgd)	Year	Description
Binghamton-Johnson City	2.2	1977	Chenango Interceptor
	3.0	1977	Infiltration Control
		1977	Storm Overflow
	24.0	1977	Aeration and Clarifier
	29.0	1977	Raw Wastwater Pumping
	20.5	1983	Nitrification
	20.5	1985	AWT Add-ons
Endicott	0.8	1977	Nanticoke Valley Interceptor
	7.5	1983	Nitrification
	7.5	1985	AWT Add-ons
East Owego	2.0	1983	Nitrification
	2.5	1985	AWT Add-ons
	2.5	2000	Secondary & Nitrification
West Owego	0.9	1977	Pressure Main from Owego Village
	-	1977	Inflow Control
	3.0	1977	Microscreening
	1.5	1977	General Expansion
	1.5	1985	AWT Add-ons

TABLE VII-16

PLAN 4 COSTS - PRESENT WORTH[1]
(MILLION $'s)

	Binghamton-Johnson City	Endicott	East Owego	West Owego	TOTAL
Wastewater Management					
Capital	8.8	3.8	1.8	2.4	16.8
O & M	21.5	10.0	4.3	3.1	38.9
Replacement	6.8	4.2	1.0	0.6	12.6
TOTAL	37.1	18.0	7.1	6.1	68.3
Interceptors					
Capital	2.5	1.6	-	0.7	4.8
O & M	-	-	-	-	-
Replacement	-	-	-	-	-
TOTAL	2.5	1.6	-	0.7	4.8
Storm Overflows					
Capital	3.6	-	-	1.0	4.6
O & M	0.8	-	-	0.1	0.9
Replacement	0.9	-	-	0.1	1.0
TOTAL	5.3	-	-	1.2	6.5
Infiltration Control					
Capital	1.2	-	-	-	1.2
O & M	-	-	-	-	-
Replacement	-	-	-	-	-
TOTAL	1.2	-	-	-	1.2
Sludge					
Capital	0.08	0.02	0.01	0.01	0.1
O & M	6.0	1.4	0.7	0.5	8.6
Replacement	0.3	0.2	0.1	0.1	0.7
TOTAL	6.4	1.6	0.8	0.6	9.4
Totals					
Capital	16.2	5.4	1.8	4.1	27.5
O & M	28.3	11.4	5.0	3.7	48.4
Replacement	8.0	4.4	1.1	0.8	14.3
TOTAL PLAN COST	52.5	21.2	7.9	8.6	90.2

[1]Based on a 50 year economic life @ 6 1/8% and ENR = 2248

MANAGEMENT AND IMPLEMENTATION PROGRAM

Plan 4-1: County Sewer Department

The Broome County Sewer Department would be responsible for all county planning and managing of sewage collection and treatment facilities; assume all outstanding indebtedness for existing regional collection and treatment facilities; writing standards for new sewer system construction; and oversee local construction. The Tioga County Sewer Department would serve a similar function for that county.

Endicott, Union, and Owego Town should convert from flat rates and property tax to metered rates and industrial surcharges. Sinking funds should be created as per Federal grant requirements (industrial grant recovery) and as required to finance new construction and replacement. Portions of Federal grants recovered from industry could subsidize low income families.

Local cost sharing for treatment, sewerage, and O & M expenses would be apportioned equally by all users in each county. A composite unit charge for pollutants such as BOD and suspended solids would be applied to industrial users in each county.

A limited education program should be provided to demonstrate to the consumer the advantages of installing water saving plumbing devices in the home. This program would be the responsibility of the Southern Tier East Regional Planning Board.

Plan 4-2: Two County Authority

Due to differences in institutional arrangements, Plan 4-2 would differ from Plan 4-1 in the following areas. The bicounty authority (through the State Legislature) would be responsible for planning and managing all sewage collection and treatment facilities in both Broome and Tioga Counties; assume all outstanding indebtedness for existing regional collection and treatment facilities. The local communities would be responsible for financing new local sewers and old collection debt service. Sewage rates would be equalized throughout Broome and Tioga Counties.

Implementation

This plan fulfills most EPA requirements for Step 1, facilities planning (Section 201 of P.L. 92-500). The remaining steps, following plan selection and approval in Step 1, would include detailed design (Step 2), construction (Step 3), and formation of necessary institutions. The implementation time for Plan 4 would be highly variable as either institutional arrangement would require the approval of the State Legislature.

REVISION PROGRAM

Five Year Revision

The following activities should be considered 5 years after plan selection for both Plans 4-1 and 4-2.

1. Initiate detailed design of AWT facilities. Needed capacity to be based on estimate of effectiveness of pricing in reducing water consumption and revised wastewater flow projections.

2. Effectiveness of infiltration control measures.

3. Need for sewerage extensions.

4. Performance of treatment facilities.

5. Changes in capital improvement program based on new priorities.

Decision Oriented Revision

1. Condition - Capital improvement program results in heavy financial burden without commensurate improvements in water quality. Possible revision: delay construction schedules.

2. Condition - Major interceptors reach capacity. Possible revisions: (a) new treatment plant to relieve load; (b) infiltration control; (c) flow equalization and storage at pump stations or with industrial users.

SUMMARY OF FINAL PLANS

In summary, 4 Plans for Choice have been presented in final plan detail. The Baseline Plan (No. 1) represents a static physical condition, or "no action" plan except for those projects expected to be constructed by 1977. The other 3 "action" plans would provide improvements in wastewater management by:

1. Expanding and/or upgrading existing facilities to meet the projected increases in flows and various water quality objectives;

2. Reducing infiltration in the City of Binghamton sewers;

3. Providing suggestions for nonstructural flow reduction;

4. Treatment of combined sewer overflows (microscreens and chlorination) for the City of Binghamton and Village of Owego systems;

5. Providing the most environmentally acceptable and cost effective sludge management system (land application of liquid sludge on agricultural land);

6. Providing two alternative institutional arrangements for plan implementation and management.

Plans 2 and 3 each have three alternative ways to treat Chenango Valley wastewater: initial sewering for all of the Chenango Valley service area with treatment at the Binghamton-Johnson City STP (Plans 2A, 3A); initial swering for all the Chenango Valley service area with treatment provided at a new Chenango Valley STP (Plans 2B, 3B); and sewering an initially reduced service area (Phase I) with treatment at an initially smaller new treatment plant at Chenango Valley (Plans 2C, 3C). By providing nitrification facilities at the Binghamton-Johnson City STP, Plan 3 would

result in slightly higher river DO levels than would Plan 2 (secondary treatment).

Plan 4 would regionalize Chenango Valley with the Binghamton-Johnson City service area and Owego Village with the West Owego service area. This plan would use advanced waste treatment to approach the Corps of Engineers definition of the National zero discharge goal.

A description of the final 4 plans and total present worth cost is presented in Table VII-17.

TABLE VII-17

FINAL PLANS SUMMARY

Plan No.	Description	Year 2020 DO Levels with Daily Pollutant Loadings @ MA-7-CD-10 Flows		Number of Plants		Binghamtons Infiltration Control (mgd)	Non-Structural Measures	Institutions	Total Present Worth (Million $'s)**
		Minimum Instantaneous	Minimum Daily Avg.	Broome Co.	Tioga Co.				
1	Baseline	3.0	3.5	2	3	0	None	Existing	31.9
2A	Secondary	3.9	4.4*	2	3	1.0	None	Modified or District	47.2
2B	Secondary	4.0	4.5*	3	3	1.0	None	Modified or District	47.7
2C	Secondary (Phased Service)	4.0	4.5*	3	3	1.0	None	Modified or District	47.7
3A	Secondary + Nitrification	4.9	5.4	2	3	3.0	None	Modified or District	50.5
3B	Secondary + Nitrification	5.0	5.5	3	3	3.0	None	Modified or District	51.1
3C	Secondary + Nitrification	5.0	5.5	3	3	3.0	None	Modified or District	51.1
4	Advanced Waste Treatment	6.2	6.7	2	2	3.0	Pricing & Education	County Dpt or Two-Co. Authority	90.2

* Contrevention of NYSDEC standard for minimum daily average DO (5 mg/1) may occur after 1994.

** Includes all capital, O & M, and replacement costs; 50 year economic life @ 6 1/8%.

IMPACT ASSESSMENT

For the most part, the analyses of impacts conducted during the previous iterations were of sufficient detail so that little additional analysis remained. The impact assessment and evaluation conducted for the final plans attempted to refine points of concern within a particular plan. Each plan was assessed for impacts on aquatic and terrestrial ecology, resource committments, and social and economic factors. Each category denotes the short term impacts associated with construction as well as the long term impacts associated with their operation. A summary of the impacts is presented in Table VII-20 following this section. The Impact Assessment and Evaluation Appendix contains the complete analysis.

AQUATIC ECOLOGY - LONG TERM

Dissolved Oxygen (DO)

The New York State standard for dissolved oxygen in both the Susquehanna and Chenango Rivers is a minimum daily average of 5.0 mg/l and a minimum instantaneous of 4 mg/l. The minimum daily average DO concentrations predicted by the computer model for the Susquehanna River by the year 2020 were: 3.5 mg/l for the Baseline Plan, 4.4 to 4.5 mg/l for Plan 2 (secondary treatment), 5.4 to 5.5 mg/l for Plan 3 (secondary plus nitrification), and 6.7 mg/l for Plan 4 (advanced waste treatment). The Baseline Plan would result in water quality violations. The predicted value for Plan 2 would, under extreme conditions by the year 2020 drop below the minimum daily average of 5.0 mg/l, but would never be less than the minimum instantaneous standard of 4 mg/l (except for Plan 2A).

An important fact to keep in mind is that these DO values would occur only in a small segment of the Susquehanna River (about 5 miles) for only a few days during the MA-7-CD-10 flow conditions (minimum average 7 consecutive day flow occurring once in 10 years). The DO level cited for each plan may occur approximately once in 10 years in the Susquehanna River, between the Endicott STP and the East

Owego STP. Before and after this location in the river, the DO level would be higher than the stated value. During most of the year and during other years of higher river flows, the instream DO achieved by any plan would be substantially higher than that indicated above. Thus, only during very low flow years late in the planning period (year 2020) would the minimum daily average DO drop below 5.0 mg/l for Plan 2 (secondary treatment). The minimum instantaneous DO during low flow periods would never drop below 4.0 mg/l for this Plan (except possibly for Plan 2A).

Those plans (labelled B and C) which included a separate plant for Chenango Valley would have a slight impact upon the DO level in the Chenango River, i.e., the minimum daily DO concentration would be reduced from an average of 7 mg/l to 6.7 mg/l or 6.8 mg/l just prior to the confluence of the Chenango and Susquehanna Rivers. However, those plans (labelled A) providing treatment of Chenango Valley wastewater at Binghamton-Johnson City would have no impact on the Chenango River and only a slight impact in the Susquehanna River by lowering the DO approximately 0.1 mg/l.

None of the action wastewater management plans would have an impact on fish spawning and none of the action plans would create any significant fish mortalities due to oxygen depletion. However, there could be periods of reduced fish activity particularly in the 5 mile reach of minimum DO between the Endicott and East Owego STP's. The lower the DO achieved by a particular plan, the greater would be the adverse impacts upon fish activity.

Nutrients

A nutrient is any element necessary to the growth and reproduction of aquatic flora. Nitrogen and phosphorus are are important factors in eutrophication and nuisance aquatic plant growths. Plan 4, which would provide advanced waste treatment, would result in the lowest nutrient loadings from treatment plant effluents. However, none of the action plans were expected to cause a significant increase in the growth of aquatic plants.

Ammonia

The New York State standard for ammonia specifies a maximum of 2.0 mg/l at pH 8 or above. No ammonia toxicity problems are expected for any plan, including the Baseline, as long as all sewage treatment plants are operating properly.

Chlorine

As presently formulated, all plans would utilize chlorine to disinfect wastewater effluent. As chlorine can be toxic to fish and other aquatic organisms, dosages should be minimized sothat the advantages of bacterial disinfection are not over-shadowed by adverse impacts to aquatic life. A possible mitigating measure is the substitution of ozonation as a disinfectant.

The average daily pollutant loads discharged to the Susquehanna River as a result of each plan, are presented in Table VII-18.

AQUATIC ECOLOGY - SHORT TERM

Temporary impacts to aquatic ecosystems would result during construction of interceptors and force mains across rivers and streams. Such river crossings would temporarily increase sedimentation and siltation within surface waters and may create locally stressful conditions to aquatic flora and fauna.

In the Baseline Plan, only one crossing would be required. All other plans require two river crossings and thus, have approximately equal short term impacts regardless of the degree of regionalization.

TABLE VII-18

AVERAGE DAILY POLLUTANT LOADS TO
THE SUSQUEHANNA RIVER (lbs/day)

Wastewater Flow (mgd) of Pollutants (lbs/day)	Existing (1975)	YEAR 2020					
		1	2A	2B-2C	3A	3B-3C	4
Flow	25.1	39.0	40.1	40.1	38.1	38.1	31.7
BOD							
warm months	5,500	8,600	5,700	5,700	4,200	4,600	600
cold months	6,100	13,500	6,900	7,300	5,800	4,600	600
NOD							
warm months	10,700	16,900	16,300	16,500	13,200	10,900	700
cold months	16,400	27,300	26,300	29,100	24,400	18,200	700
Suspended Solids	6,200	12,200	6,800	6,800	6,300	6,700	600
Nitrogen	4,500	6,800	7,500	7,500	6,800	7,500	600
Phosphorus	1,200	1,700	1,900	1,900	1,700	1,900	150

TERRESTRIAL ECOLOGY - LONG TERM

During the operation of a wastewater management system, impacts to terrestrial ecology are related to interceptor and sludge disposal.

Interceptors

Construction of interceptors may induce development in areas which are not presently serviced by existing wastewater treatment facilities. However, most of the development that may occur under any plan is also projected to occur under the Baseline Condition. Therefore, although development in presently undeveloped areas would occur, the long term impact of any plan on terrestrial ecology would not be substantially different than what may be expected under the Baseline Condition.

Land Application of Sludge

Application of liquid sludge to agricultural land in all action plans would require land for both application and storage. The land requirements vary depending on the level of wastewater treatment. Plans 2 and 3, providing secondary and improved secondary treatment, respectively, would require 1,770 acres of cropland for sludge application and 7.2 acres for storage in lagoons during the winter months. Plan 4, advanced waste treatment, would produce more sludge and, therefore, would require more land area. This system would require 2,765 acres for sludge application and 16 acres for storage.

Resources recycled to the land (e.g., nitrogen, phosphorus, potassium, organic matter) by land application of liquid sludge would represent a beneficial impact to agricultural production in the area, since many soils are nutrient deficient and may also be low in organic matter. The sludge obtained from the advanced waste treatment of wastewater would return the most amount of nutrients to the land in comparison to other treatment systems.

Possible adverse impacts to the terrestrial ecosystem may result from heavy metals in the sludge. Heavy metals accumulating in the soil may be biologically concentrated in the crops or in wildlife which is associated with agricultural lands or may be leached to groundwaters. The problems of heavy metal toxicity may be mitigated by adjusting application rate of the liquid sludge; by selecting crops which are less sensitive to heavy metals or which do not tend to biologically concentrate heavy metals; and by adding lime to the soil thereby raising the pH of the soil to levels at which heavy metals are less toxic.

Should landfill of sludge replace land application, Plans 2 and 3 would require 226 acres for landfill (the Baseline Plan would require slightly less as not all areas would be sewered). Plan 4 (AWT) would utilize 360 acres for landfilling.

TERRESTRIAL ECOLOGY - SHORT TERM

Temporary impacts to terrestrial ecology would occur during the construction of facilities such as treatment plants, effluent outfalls, and interceptors. Direct adverse impacts would occur to terrestrial vegetation and associated wildlife habitat. Installation of pipelines may also result in erosion.

Plans labelled B and C which utilize a separate Chenango Valley treatment plant would need approximately 5 acres of a presently vacant weedy area adjacent to Route 11 near the Broome Community College. The vegetation and wildlife associated with these 5 acres is similar to recently abandoned farmland. Its utilization for a treatment plant site would not have major adverse impacts to the terrestrial ecology of the area.

Construction of interceptors and effluent outfalls would directly effect terrestrial ecology when such pipelines are constructed through unbroken land. A measure of the extent of such direct adverse impacts is the number of miles of pipeline to be constructed which do not follow existing roadways. The higher the degree of regionalization, the more miles of interceptor pipe required, and, therefore, the greater the disruption. The Baseline Plan would result in direct adverse impacts along 4.0 miles of regional interceptors. Other plans would impact upon additional areas depending on the degree of regionalization.

Plans 2A, 3A, and 4, which regionalize Chenango Valley with Binghamton-Johnson City, would construct an additional 4.3 miles of interceptors not following roadways compared to 2.8 miles for plans (labelled B and C) providing separate treatment at Chenango Valley. Plans labelled B and C would also require a 400 foot effluent outfall. Much of the area around these pipelines lies within the flood plain of the Chenango River and erosion may become a problem during construction.

In Plan 4, not only is Chenango Valley regionalized with Binghamton-Johnson City, but Owego Village is also regionalized to the West Owego service area. This latter construction would require 0.9 mile of construction not along roadways. Thus, in Plan 4, adverse terrestrial impacts would occur along 5.2 miles of interceptor construction.

RESOURCE COMMITMENTS

Resources commited to wastewater management systems may be classified as either consumptive (irretrievable) or nonconsumptive (retrievable). Commitments of land acreage to a wastewater management scheme are made for at least the life of the wastewater management project, but may be converted to other uses after the abandonment of the wastewater project. Land commitments are therefore nonconsumptive uses of local resources. On the other hand, resources such as chemicals, electricity, and fuel are consumed during wastewater treatment and disposal and, therefore, represent irretrievable commitments of resources. Resource commitments are displayed in the Impact Assessment Summary, Table VII-20.

Land Commitments

The major land commitments associated with wastewater management are those areas devoted to physical facilities (e.g., treatment facilities) and the land application of sludge.

Those plans (2A, 3A, 4) which provide for separate treatment of wastewater in the Chenango Valley area would require a commitment of approximately 5 acres of flood plain land for a new STP.

For each of the action plans, stormwater overflow control facilities (microstrainers) would be constructed at the five locations shown on Figure VII-1. The surrounding land use at these sites is presented in Table VII-19. Only a small commitment of land (1 to 2 acres each) would be required for these facilities, but would be located in an urbanized area. Some land would also be required in the Village of Owego to construct microstrainer facilities and possibly inflow control measures.

Land application of liquid sludge would require the commitment, for at least the life of the project, of 1,770 acres of agricultural land for Plans 2 and 3 and 2,765 acres for Plan 4 (AWT). Since lands required for sludge application are already used for agricultural activities, no unalterable committments of land would be made.

However, the land required for storage (7 acres for Plans 2 and 3 and 16 acres for Plan 4) can be considered an irretrievable commitment as this land could not easily be restored to its original condition.

CITY OF BINGHAMTON
LOCATION OF PLANNED OVERFLOW CONTROL FACILITIES

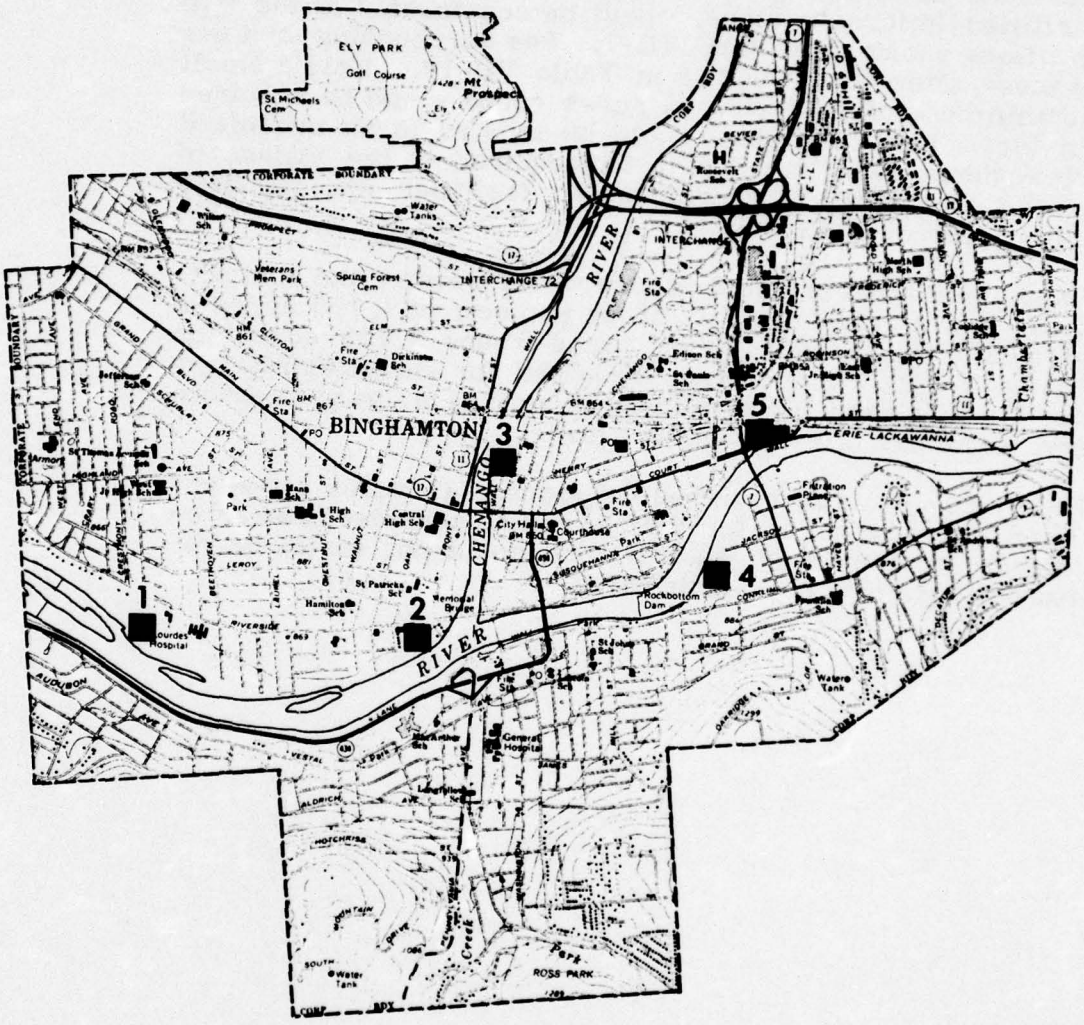


FIGURE VII-1

TABLE VII-19

CHARACTERISTICS OF STORM OVERFLOW MANAGEMENT SITES

Storm Overflow Site	River + Mile Point	Surrounding Land Uses
1	Susquehanna MP 37.7	Residential (medium density) - 100%
2	Susquehanna MP 38.7	Residential (high density) - 50% Vacant - 50%
3	Chenango MP 0.7	Light manufacturing - 50% Commercial (urban) - 50%
4	Susquehanna MP 40.0	Light manufacturing - 100%
5	Susquehanna MP 41.0	Shrub Wetland - 40% Commercial Strip - 30% Residential (high density) - 30%

Electricity

The amount of electricity consumed is dependent on the level of treatment. Plan 2, providing secondary treatment, would not require significantly more electricity than the Baseline Plan. Plan 3, providing nitrification, would consume about 43 percent more electricity than the Baseline Plan. The AWT Plan (No. 4) would consume about 79 percent more electricity than the Baseline Plan.

Chlorine

Consumptive use of chlorine would occur in all plans including the Baseline. Chlorine would be used for disinfection of treatment plan effluent in all the plans and would be used for stormwater disinfection in the action plans.

The amount of total chlorine used for disinfection of STP effluents will depend on the level of prior treatment. Generally, a higher level of treatment prior to effluent disposal will require less chlorine for disinfection. In those systems emphasizing secondary treatment or secondary treatment with nitrification (Plans 2 and 3), the amount of chlorine utilized is not significantly different than the amount of chlorine used under the Baseline Plan (about 270 tons/year).

Biological advanced waste treatment (Plan 4) would utilize about one-half of the chlorine required by the Baseline Plan. Since chlorine shortages have appeared at sewage treatment plants around the country in the past year, this reduction may represent a beneficial impact upon nationwide chlorine resources.

The amount of chlorine used for stormwater disinfection would amount to 3.7 tons per year, a small fraction compared to that required for treatment plant effluents.

Lime

Wastewater treatment and disposal processes consuming lime would be the vacuum filtration of sludge and land application. Lime would be used in the latter process primarily as a mitigating measure against heavy metal toxicity. Lime, however, is generally used by farmers for soil enrichment and the amount required for applying sludge would probably not greatly differ from that already used by farmers. No plan would use significantly more lime than that required for the Baseline.

Activated Carbon

Activated carbon would be used for the reduction of BOD and refractory organics only in the AWT system (Plan 4). Under this plan, 121 tons per year of activated carbon would be utilized which may have an adverse impact, depending on the future availability of this resource.

Methanol

Methanol, or wood alcohol, would be used only in the system for denitrification. The amount, 3,570 tons/year, of methanol required by Plan 4 may represent an adverse impact depending upon the availability and cost of methanol in the Binghamton area and in the nation as a whole.

Coagulants

Coagulants in the form of alum and/or polymers are required for phosphorus removal in only the advanced waste treatment scheme. The amount of polymers required, 65 tons/year, would most likely be insignificant in terms of its availability, although the cost of polymers is generally high. The consumptive uses of alum, 10,400 tons/year, would represent a significant increase in the utilization of this chemical, and may adversely impact upon available resources, particularly in the Binghamton area.

Fuel

Fuel would be utilized primarily in the regeneration of activated carbon in the AWT system (Plan 4), and for the transportation of sewage sludge to land application (or landfill) sites. The major source of fuel consumption of 14,000 to 15,000 gallons/year, in the Baseline Plan, Plan 2, and Plan 3, would be for the transportation of sludge. The consumption of fuel in these plans would be less than 0.01 percent of the fuel consumed by all motor vehicles registered in Broome and Tioga Counties.

In comparison, Plan 4 would use about 160,000 gallons per year, representing 0.11 percent of areawide consumption. This use of fuel may become a significant adverse impact especially if this resource becomes a critical commodity.

SOCIAL IMPACTS - LONG TERM

Growth and Development

It is assumed projected population growth and development in the Study Area would occur whether or not sewerage services are provided. However, growth would tend to concentrate within and near areas which provide sewerage services.

Haphazard expansion of sewerage services which could occur under the Baseline Plan may or may not result in development patterns which are desired either on the local or regional level.

On a regional basis, development induced by any of the "action" plans would conform to desired patterns as expressed in the General Plan for Broome and Tioga Counties (Egner and Niederkorn Assoc., Vol. 4, 1972). Regionalization of waste treatment facilities have the greatest potentials to affect future local development patterns but no undesirable development would be likely to occur.

Land application of liquid sludge in all action plans would have no adverse impacts associated with conflicting land use, as only areas designated for agriculture would be used. Should landfills for sludge be required, it is expected that lands already designated for that purpose would be used.

Public Health

The elimination of septic system failures and overflows into area waterways would be a beneficial impact achieved by all action plans in comparison to the Baseline Plan. Furthermore, the treatment of combined sewer overflows would represent an additional beneficial impact to public health.

All wastewater management systems contribute to the in-stream concentrations of total and fecal coliform. The major factors influencing total coliform contributions is the overflow of combined sewers. The second major contributor to total coliform concentrations is the Binghamton-Johnson City STP effluent.

The Baseline Plan, although providing secondary treatment at five plants, would most likely contribute significant quantities of coliform to the river because of overloading of treatment facilities. In addition, since combined sewer overflows would continue without any treatment, coliform concentrations during storm conditions would be as high as 240,000 MPN/100 ml in the Susquehanna River and 123,000 MPN/100 ml in the Chenango River, well in excess of water quality standards (2,400 and 10,000 MPN/100 ml for Class B and Class C, respectively).

The "action" plans would reduce coliform concentrations to levels acceptable for primary contact recreation in the Susquehanna and Chenango Rivers during both low river flows and design storm conditions.

The extent and timing of sewer service within the Chenango Valley area would influence the public health impacts of subplans labelled A, B, or C. Plans labelled A or B would provide immediate full service to the Chenango Valley area experiencing septic system problems. Plans labelled C, however, would initially provide service to only a part of the Chenango Valley. Areas of the Valley (such as Nimmonsburg), which are experiencing septic system problems would not have sewerage services until at least 5 years after construction of the first phase collection system and treatment plant. Provision of a short, direct outfall from the Chenango Valley STP to the Chenango River at a point above the Route 81 River Park would have no significant impacts upon the bacteriological characteristics of the Chenango River primarily because of two factors: the effluent flow would be less than 1/40 of the estimated MA-7-CD-10 river flow, and the effluent would be disinfected prior to discharge.

Air Quality

The Binghamton area has received a preliminary designation as an Air Quality Maintenance Area. However, it is probable that none of the plans would significantly affect air quality in this area.

Employment

Operation of facilities in any plan would require workers of various skills. Plans 2 and 3 would provide a small increase in employment when compared to the Baseline Plan. Most workers would probably come from the local labor force. However, Plan 4 would require more than twice the number of workers needed in the Baseline Plan. It is likely that those jobs requiring an advanced technical-professional background in Plan 4 would not be filled by workers from the local labor force.

Recreation

Some improvements to potentials for secondary water contact recreation, particularly fishing, may result from those plans which provide for high dissolved oxygen, low ammonia and chlorine, and low nutrient concentrations within the area's waterways in comparison to the Baseline Plan.

Significant reductions in total and fecal coliform, especially as a result of treatment of combined sewer overflows, would improve the potentials for primary water contact recreation in all action plans as compared to the Baseline Plan.

It should be kept in mind that although a wastewater management plan may improve the potentials for recreation, no plan would result in significant increases in participation of water-related activities unless the other problems, such as access, which presently restrict such recreation are also solved.

Adverse public perception of the water quality of the Chenango River at the Route 81 River Park due to an effluent discharge from a Chenango Valley STP may adversely affect the recreational potential of the Park. Such adverse aesthetic perceptions would have no bearing in terms of actual bacteriological quality, however.

Aesthetics

Wastewater management facilities may produce dust, noise, and odors during operation and may be visually unaesthetic.

Dust and noise produced during operation of sewage treatment plants is usually minimal, although odors may become a problem particularly if a plant is overloaded or if it is not operated properly. Odors, therefore, may be particularly offensive under the Baseline Plan since by the year 2020, all sewage treatment plants would be overloaded. Assuming proper operation and maintenance, sewage treatment plants in the other plans should create no offensive odor problems. Stormwater overflow management facilities would create only negligible dust, noise, and odor problems. Odors eminating from sludge lagoons, in all of the action plans, may be particularly offensive to nearby residents during the six months of winter storage. Should landfilling of sludge be required, care must also be taken so that offensive odors would not develop.

SOCIAL IMPACTS - SHORT TERM

Historic, Cultural, and Archeological Sites

No national historic sites would be impacted during either construction or operation of any wastewater management facility. Locally important historic and cultural sites in the Village of Owego, particularly on Front Street would be temporarily impacted, via dust and noise, during the construction of an interceptor between the Owego Village STP and the West Owego STP (Owego STP #1) in association with the AWT plan (Plan 4).

Construction of wastewater management facilities including sewage treatment plants, interceptors, transmission pipelines, and stormwater treatment facilities would involve extensive digging within the Susquehanna and Chenango River valleys and may thus disturb important archeological sites. An archeological reconnaissance was conducted in areas where any construction was proposed for the final plans. The results of this investigation are presented in Chapter VIII of the Speciality Appendix. As highlighted in this archeological report, most of the proposed construction for any "action" plan would be in the valley of the Susquehanna and Chenango Rivers where the incidence of archeological artifacts is high. Therefore, detailed surveys should be undertaken prior to the final siting or alignment of any facility in minimize the adverse impacts.

Employment

Construction of sewers, treatment plants, and stormwater management facilities under the action plans would provide for greater construction employment opportunities than the Baseline Plan. However, it is likely that any action plan would provide about the same employment opportunities as any other plan except for Plan 4 which would create more short term construction opportunities.

Recreation

Parks and other recreational places may be temporarily disturbed during construction of various wastewater management facilities in connection with any of the "action" plans.

With the subregionalization plans (labelled B and C), construction of the Chenango Valley STP, its outfall to the Chenango River would temporarily disturb recreational activities within the Route 81 River Park.

This park would also be temporarily disrupted, however, with the construction of an interceptor from the Chenango Valley area to the Binghamton-Johnson City sewer system.

Construction of overflow control facility No. 3 would take place near Stow Park in the City of Binghamton and may temporarily affect recreational activity.

Aesthetics

The creation of dust, noise, and traffic detours and delays, would be created at or near various sites of construction activities.

Construction of a new sewage treatment plant in the Chenango Valley area would temporarily impact upon the local residents, and the users of the new Route 81 River Park through which the effluent outfall of the new STP would be constructed.

A measure of the amount of construction impacts (e.g., dust, noise, traffic delays, etc.), associated wth the construction of interceptors is the number of miles of such pipelines which would be constructed along existing roadways. The Baseline Plan would create such temporary disturbances along approximately 4.5 miles of new interceptors. Plans providing separate treatment at Chenango Valley would result in temporary construction disturbances along an additional 1.4 miles of regional interceptor adjacent to existing roads compared to 2.3 miles for plans which regionalize Chenango Valley with Binghamton-Johnson City.

Plan 4, which regionalizes Owego Village with West Owego, would create construction impacts along 0.9 miles of roads in addition to the 2.3 miles for Chenango Valley regionalization and the 4.5 miles included in the Baseline.

ECONOMIC FACTORS

The socio-economic impacts associated with the costs of any wastewater management plan are reflected by such questions as:

How much does it cost?

Who pays for it?

How significant are the costs to those who pay?

The annual per capita costs of each plan are presented in the Impact Assessment Summary for Stage III-2, Table VII-20. The costs include: wastewater collection, treatment and disposal, sludge treatment and disposal, infiltration control, stormwater overflow treatment, and non-structural flow reduction measures.

The figures assume the following:

a. Construction - 75% Federal, 12 1/2% State, 12 1/2% Local.

b. Operation and Maintenance - 33% State, 67% Local.

c. Zero % Inflation

d. Zero % Income Rise

e. 6 1/8% interest rate for bonds (as mandated by current Water Resources Council guidelines) for a period of 50 years.

The average annual per capita cost to a residential user for Plans 1, 2, and 3, was computed as a uniform series of annual payments, equal in present worth to the total present worth of the actual projected residential payments. For these plans, the actual annual per capita costs are fairly uniform. Plan 4, however, would result in much higher payments after 1985 than before. For this system, the impact on the residential user is better expressed as a "typical" payment after 1985. The year 2000 was used as the typical year.

Per capita annual costs for any plan would vary depending on the service area, level of treatment, and degree of regionalization. The Baseline Plan, which provides for no additional improvements to sewage treatment facilities after 1977, would have the least annual per capita payment within each service area. Plan 2, providing secondary waste treatment, is the next least costly for the Chenango Valley and Binghamton-Johnson City sevice areas. Plans 2 and 3 are of equal cost to the Endicott, East Owego, West Owego, and Owego Village service areas because the costs of nitrification in Plan 3 accrue only to the B-JC STP. Advanced waste treatment, Plan 4, would be the most costly for each service area.

The costs indicated regionalization of Chenango Valley with the Binghamton-Johnson City service area (Plans 2A, 3A) would be cheaper for the Chenango Valley resident than plans (labelled B and C) providing a separate STP for this area. However, this assumed the proposed institutional modification to change the present billing formula used by Binghamton-Johnson City would be implemented. Under the present formula, subregionalization would be cheaper for the Chenango Valley resident. For the Binghamton-Johnson City service area resident, there would be no significant cost difference between regionalization and subregionalization.

A measure of the socio-economic impacts to families within any service area is the percent of the total mean family income which would be spent for wastewater treatment. For the service areas of Binghamton-Johnson City, Endicott, East and West Owego, and Owego Village, the percent of family income devoted to wastewater costs for Plans 2 and

3 would not significantly differ from the Baseline. Expenditures under Plan 4 would double the Baseline costs. Families most affected would be those in the West Owego and Owego Village service areas as 0.4 percent of the mean income would be spent for advanced waste treatment.

In the Chenango Valley service area, the costs to families for existing septic systems represents only a minor portion of family income. Therefore, all action plans have the potential to adversely affect the socio-economic characteristics of the average Chenango Valley resident.

TABLE VII-20

IMPACT ASSESSMENT SUMMARY STAGE III-2

(YEAR 2020)

IMPACT INDICATORS ECOLOGICAL	1 BASELINE PROFILE	2A 4mg/1 5 STP PLAN	2B 4mg/1 6 STP PLAN	2C 4mg/1, 6 STP FIRST PHASE STP PLAN	3A 5mg/1 5 STP PLAN	3B 5mg/1 6 STP PLAN	3C 5 mg/1, 6 STP FIRST PHASE STP PLAN	4 BIOLOGICAL AWT 4 STP PLAN
1. # Major Stream Crossings	1	2	2	2	2	2	2	2
2. DO (mg/1)								
a) Minimal daily average: Year 2020, MA-7-CD-10	3.5	4.4	4.5	4.5	5.4	5.5	5.5	6.7
b) Minimum instantaneous Year 2020, Design Storm	3-4	4-5	4-5	4-5	4-5	4-5	4-5	5-6
3. Total N lb/day (Stream)	6830	7540	7540	7540	6830	7540	7540	585
4. Total P lb/day (Stream)	1740	1905	1905	1905	1740	1905	1905	145
5. NH_3 (mg/1) at minimum DO (Stream)	1.74	1.69	1.69	1.69	0.94	0.94	0.94	0.15
6. Benefit to Fishery Potentials of Limited Area	None	Slight	Slight	Slight	Moderate	Moderate	Moderate	Moderate
7. Maximum Total Coliform (MPN/100 ml) (Stream)								
a) MA-7-CD_{10}	<1000	360	340	340	360	340	340	360
b) Design Storm (Stream)	240,000	1040	1025	1025	1025	1025	1025	1040
8. Acreage for new STP	0	0	5	5	0	5	5	0
9. Acreage for Land Application of Sludge & Storage	-	1777	1777	1777	1777	1777	1777	2781
10. Acreage for Possible Landfill	150-200	226	226	226	226	226	226	360
11. Miles of Regional Interceptors not Along Existing Roadways	4.0	8.3	6.8	6.8	8.3	6.8	6.8	9.2
RESOURCES COMMITTMENTS								
1. Total Land Requirements (acres)	-	1777	1782	1782	1777	1782	1782	2781
2. Electricity (KWHr/Yr)	$11.2x10^6$	$11.5x10^6$	$11.5x10^6$	$11.5x10^6$	$16x10^6$	$16x10^6$	$16x10^6$	$20x10^6$
3. Chlorine (tons/yr)	271	282	282	282	267	267	267	147
4. Lime (tons/yr)	798-1198	840-1261	840-1261	840-1261	840-1261	840-1261	840-1261	1383-2074
5. Activated Carbon (tons/yr)	-	-	-	-	-	-	-	121
6. Methanol (tons/yr)	-	-	-	-	-	-	-	3570
7. Coagulants								
a) Alum (tons/yr)	-	-	-	-	-	-	-	10400
b) Polymers (tons/yr)	-	-	-	-	-	-	-	65
8. Fuel (gal/yr)	13,900	14,700	14,700	14,700	14,700	14,700	14,700	158,700

TABLE VII-20 (cont'd)

IMPACT ASSESSMENT SUMMARY STAGE III-2

(YEAR 2020)

IMPACT INDICATORS ECOLOGICAL	1 BASELINE PROFILE	2A 4mg/1 5 STP PLAN	2B 4mg/1 6 STP PLAN	2C 4mg/1, 6 STP FIRST PHASE STP PLAN	3A 5mg/1 5 STP PLAN	3B 5mg/1 6 STP PLAN	3C 5 mg/1, 6 STP FIRST PHASE STP PLAN	4 BIOLOGICAL AWT 4 STP PLAN
SOCIAL								
1. Miles of regional interceptors along existing roadways	4.5	6.8	5.9	5.9	6.8	5.9	5.9	7.7
2. # historic sites disturbed	0	0	0	0	0	0	0	0
3. # recreational places disturbed	0	2	2	2	2	2	2	2
4. Improvement to Secondary Water Contact Recreation Potentials	None	Slight	Slight	Slight	Moderate	Moderate	Moderate	Moderate
5. Improvement to Primary Water Contact Recreation Potentials	None	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
6. # Families Displaced	0	0	0	0	0	0	0	0
7. Result in locally desired development patterns	May or May not	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. Result in regionally desired development patterns	May or May not	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9. Contravene air quality standards	No	No	No	No	No	No	No	No
10. Manpower Requirements	59	66	73	73	66	71	71	121
ECONOMIC								
Annual per capita costs (1975$)								
1. Chenango Valley Service Area	-	4.17	5.98	5.98	4.43	5.98	5.98	9.47
2. B-JC Service Area	3.69	4.17	4.30	4.30	4.43	4.59	4.59	9.47
3. Endicott Service Area	4.09	4.57	4.57	4.57	4.57	4.57	4.57	9.11
4. E. Owego Service Area	5.97	6.71	6.71	6.71	6.68	6.68	6.68	13.18
5. W. Owego Service Area	7.66	8.13	8.13	8.13	8.13	8.13	8.13	23.82
6. Owego Village Service Area	12.91	14.81	14.81	14.81	14.81	14.81	14.81	23.82
TOTAL COSTS*								
Present Worth ($106)	31.9	47.2	47.7	47.7	50.5	51.1	51.1	90.2
Average Annual ($106)	2.1	3.0	3.1	3.1	3.3	3.3	3.3	5.8

*6-1/8% interest and 50-year project life.

CHAPTER VIII

COMPARISON AND EVALUATION OF PLANS FOR CHOICE

The final product of the Study was four Plans for Choice for wastewater management in the central urban area of Broome and Tioga Counties. From this set of alternative plans, local decision makers selected the one best suited to their needs and objectives. The intent of this Chapter is to summarize the differences between plans and to discuss the sensitivity of these differences to various assumptions of the analysis. This evaluation was performed to aid decision makers in selecting a scheme by comparing the strengths and weaknesses of each plan. Based on this evaluation, the Interagency Study Management Group, composed of regional, State, and Federal agencies responsible for wastewater management planning, recommended a single plan for implementation. This plan and the reasons for the recommendation are presented in Chapter IX.

FRAMEWORK FOR PLAN COMPARISON

The final four plans left three unanswered decision components from which the recommended plan had to be selected. These three major issues were:

1. The level of treatment: Baseline (Plan 1), secondary (Plan 2), secondary with nitrification at Binghamton-Johnson City (Plan 3), or advanced waste treatment at all STP's (Plan 4).

2. Regionalizing Chenango Valley into the Binghamton-Johnson City service area (labelled A) or providing a separate Chenango Valley treatment plant (B and C). If a separate STP is provided, the desirability of phasing sewerage in

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Chenango Valley (labelled C) versus providing full service immediately (B).

3. The type of institutional arrangement to implement and manage each plan.

A framework for these decisions is outlined in Figure VIII-1. Water quality may be considered the first issue or decision component. If achieving maximum water quality is a major decision factor, only the AWT System (Plan 4) would satisfy such a concern. Selection of AWT, then, automatically selects a level of regionalization (2 plants in Broome and 2 plants in Tioga). If concern for water quality is somewhat high, i.e., a conservative approach is felt warranted but maximizing water quality is not a constraint, then Plan 3 (5 mg/l DO) should be more seriously considered. Likewise, a moderate water quality concern leads to a decision for secondary treatment (Plan 2). Little or no concern would, of course, lead to selecting Plan 1, the Baseline Condition, and essentially a course of "no action."

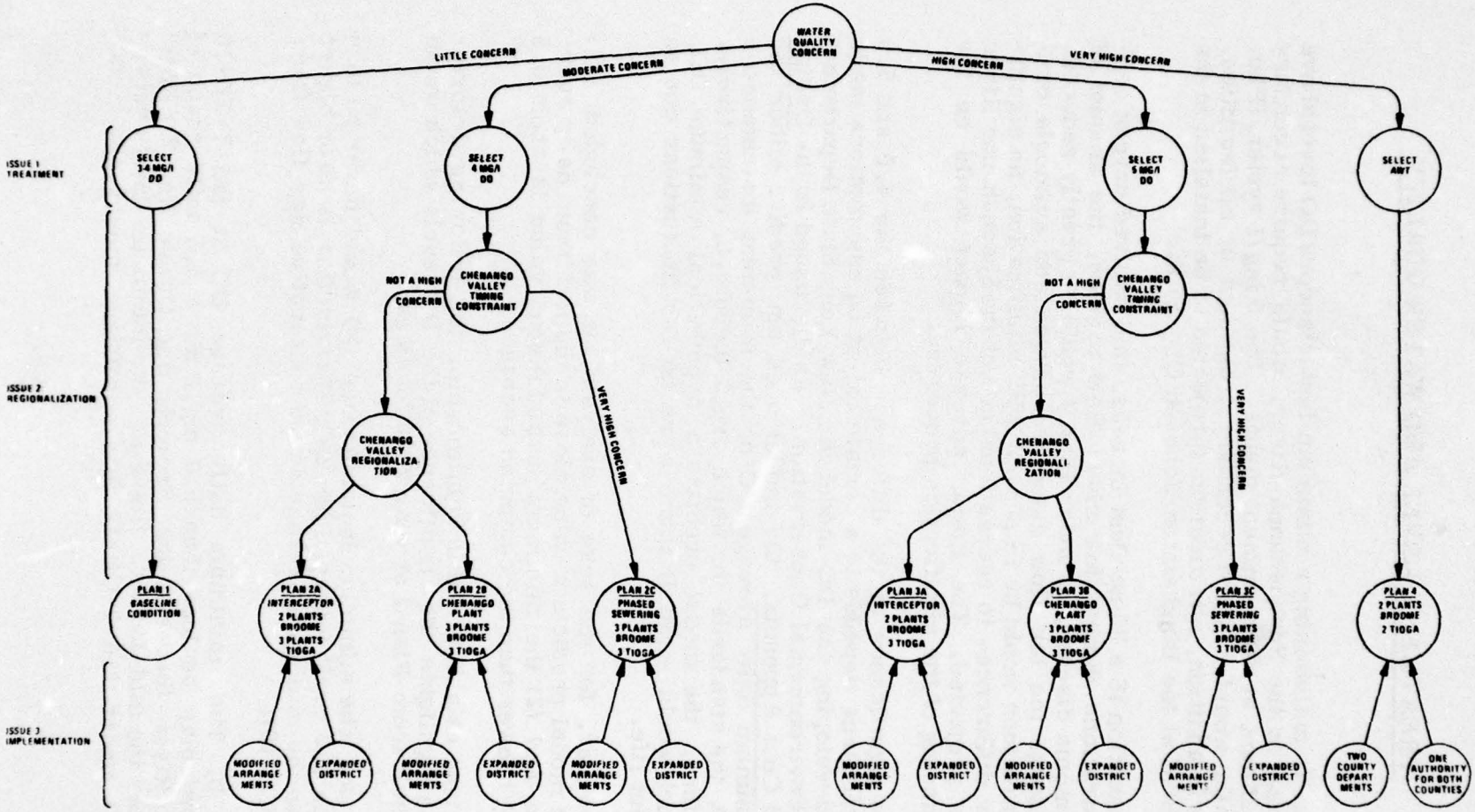
Generally, the trade-offs made for higher water quality in the region are in terms of a heavier committment of resources and more adverse economic impacts.

For Plans 2 and 3, the next component to be considered was the timing constraint for providing sewerage service in Chenango Valley. An initially limited service area (Plans labelled C) would probably have a greater chance of gaining the approval of residents than a more agressive extension policy (Plans labelled A and B). If implementation time is placed at a very high priority, then plans labelled C would be selected as they have the highest probability of being implemented the earliest. The degree of regionalization would then be three plants for Broome County.

However, if the timing constraint is not high and can be traded off against other impacts (such as providing immediate service to all problem areas), then a decision can be made as to the level of regionalization in Broome County (Plans labelled A vs. Plans labelled B).

The third issue involved the method to be used to implement and manage the selected technical system. For each action plan, two alternative institutional arrangements were provided. One method would result in less change to the existing institutions (Modified Arrangements for Plans 2 and 3 and County Departments for Plan 4), while the other would provide more uniformity in the management of wastewater treatment systems (Expanded District for Plans 2 and 3 and Bicounty Authority for Plan 4).

FIGURE VIII-1 DECISION-MAKING FRAMEWORK FOR PLAN SELECTION



TREATMENT LEVEL AND WATER QUALITY

Plan 2, maintaining a minimum instantaneous DO level above 4 mg/l in the Susquehanna River, would require secondary treatment at all treatment plants. The 5 mg/l system (Plan 3) also would require secondary treatment at all facilities, and in addition, nitrification (projected to be installed in the 1990's) at the Binghamton-Johnson City STP.

In addition to a 25 percent increase in dissolved oxygen concentrations during low river flow periods, the amount of ammonia discharged under Plan 3 would be greatly reduced. Although the low flow dissolved oxygen and ammonia concentrations would be improved with nitrification, no significant differences in recreational use of the Susquehanna River was projected. The major adverse impact would be the financing of the nitrification processes.

The significance of the difference between the 4.0 and 5.0 mg/l plans depends to a certain extent on assumptions made in developing the DO model for New York State Department of Environmental Conservation. As discussed in the Design and Cost Appendix, the model does not predict either the minimum daily average DO or the minimum instantaneous DO, the standards for which are 5.0 and 4.0, respectively. Rather, the model predicts a hypothetical minimum DO, which would exist if there were no DO fluctuations due to plant life.

However, for the sake of analysis, it was concluded: (1) the model predicts a value close to the minimum daily average; and (2) the minimum instantaneous value is about 0.5 mg/l lower than the computed average.

Having established this relationship, the following description highlights the significance of the DO levels which would result from Plan 2 at year 2020 loadings:

a. The minimum instantaneous DO would never be less than 4.0 mg/l (except Plan 2A), if river flow is at or higher than the minimum average seven consecutive day flow (MA-7-CD-10).

b. The minimum daily average DO at MA-7-CD-10 flows may be less than 5.0 mg/l for a 5.5 mile reach of the River (between the Endicott and Owego No. 2 STP's) after the mid-1990's. However, the minimum daily average DO under MA-7-CD-10 flow conditions should never fall

below 4.5 mg/l at any point in the River, at least to the year 2020.

c. For flows recorded in the 11 years, 1963-1973, and with year 2020 waste loadings, the minimum daily average DO for the critical month in each year, would have been less than 5.0 mg/l in only 2 years, the drought period 1964-1965. In some years, the minimum daily average would have been 6.0 mg/l or greater.

d. In 1965, the year in which the MA-7-CD-10 flow actually occurred, the minimum daily average DO would have been less than 5.0 mg/l six out of the eight weeks in August and September, and never less than 4.5 mg/l.

e. Any time the minimum daily average DO is below 5.0 mg/l, a maximum of 5.5 river miles (below Endicott) would be affected.

Biologically, Plan 2 satisfies the intent of the 5.0 mg/l standard, i.e., propagation and maintenance of the native fish species. This is partially due to the fact that the low DO conditions never occur in the spawning season, when fish are most sensitive to DO reductions. Furthermore, most fish have a response mechanism which leads them to avoid areas of adverse DO conditions. Finally, literature on the subject of fish response to DO reveals that, within the medium to high DO range (4.0 to 6.0 mg/l), the Susquehanna fish species can maintain normal life activities. However, fish activity would be reduced under the lower limits of this range. Therefore, concern for water quality should weigh this reduction on normal activity, for a 5.5 mile reach of the Susquehanna River for roughly two months out of 10 years, against the added cost of the Binghamton-Johnson City nitrification facilities.

Several more points should be brought out in comparing Plans 2 and 3.

1. Until 1994, the two plans are identical with regard to capital improvements, since nitrification would not be needed until that time to maintain a minimum daily average of 5.0 mg/l DO.

2. Therefore, ample time is available to check the theoretical analyses on which the Plans are based; most importantly, the sensitivity of river DO to Binghamton-Johnson City (B-JC) STP loads, and the long term performance of that STP.

3. It would be well to check the accuracy of the model's predictions (by monitoring the river) prior to committment of funds. The model calibration is based on a sampling program which was performed at relatively high flows, but in the 10-15 year time lag before detailed nitrification design must begin, much more critical conditions could occur.

4. The addition of nitrification facilities at B-JC STP would tax available space at the site. The predicted 17 year time lag before these facilities would be needed would allow time to investigate technologies geared to a reduction in space requirements, e.g., pure oxygen fluidized bed reactors, and fix film reactors.

5. There would also be time available to reassess the cost-effectiveness of infiltration control beyond the 3 mgd level used in the present analysis. If nitrification space problems would result in higher costs, it could prove cost-effective to increase infiltration control.

6. Under Plan 3, approximately $4 million for the construction of nitrification processes and $150,000 per year for the associated operation and maintenance costs would be needed at the B-JC STP.

Plan 4, advanced waste treatment, would result in a 50 percent increase in the minimum daily average DO over secondary treatment (Plan 2) and a 20 percent increase over nitrification (Plan 3) during low flow conditions. Additionally, nitrates, phosphorus, suspended solids, and dissolved organic material would be greatly reduced in effluent discharges. However, no change in the recreational use of the Susquehanna River is projected with implementation of this plan, although the quality of the river would certainly be improved. Again, the trade-offs against improved water quality are burdens of financing the system. Additionally, short term adverse construction impacts could be anticipated because of space limitations at the Binghamton-Johnson City plant. Lastly, major resource committments would be required to sustain the advanced treatment facilities. Electrical consumption for AWT would be almost double that for secondary treatment and would represent an approximate increase of 1 percent in the region's electrical consumption (which in turn could produce other environmental stresses).

BROOME COUNTY REGIONALIZATION

The significant differences between the three plant (Plans labelled B and C) and two plant systems (labelled A) for Broome County are the historic sites impacts, socio-economic impacts, and incremental construction at the Binghamton-Johnson City STP. As the plans were defined, cost-effectiveness differences were not significant, but may become so as will be discussed.

HISTORIC IMPACTS

Subregionalization would entail constructing a plant at the northern end of the Route 81 River Park and an outfall directly to the Chenango River whereas regionalization would necessitate construction of a force main through the park. Since the park may contain significant Indian artifacts, construction through the park could be considered to have a potential significant historical impact.

SOCIO-ECONOMIC IMPACTS

Regionalization (Plans labelled A) would result in higher treatment costs than subregionalization for the Chenango Valley area resident if the present billing policy of the Binghamton-Johnson City Joint Sewage Board is maintained. On the other hand, if the billing formula is modified as is proposed, then regionalization would be cheaper for the Chenango Valley resident and the costs to the B-JC resident would remain the same.

Both systems would result in adverse construction impacts to the Route 81 River Park, though overall, the force main to the Binghamton system would have impacts of a greater magnitude.

The outfall from the proposed Chenango Plant may adversely affect the recreational use of the river by impacting upon

people's perception of the river water quality, even though no significant water quality degradation is expected by discharging to the Chenango River.

CONSTRUCTION AT THE BINGHAMTON-JOHNSON CITY STP

The additional aeration and clarifier capacity needed to treat wastewater from Chenango Valley may have an adverse impact upon the stream bordering the B-JC plant if all units can not be constructed completely on the existing site.

PHASED SEWER SERVICE IN CHENANGO VALLEY

The major differences between immediate full scale sewering (Plans labelled A and B) and limited sewering (Plans labelled C) are the public health and socio-economic impacts. Full scale sewering would have a greater beneficial public health impact since all areas having septic system problems would be initially sewered, including the Chenango Bridge area. In Chenango Bridge, the need for sewers has been reported to be quite high because poorly operating individual disposal systems have: (1) deteriorated the quality of the Chenango River and (2) pose a threat to nearby water supply wells. The first phase service area in Plans 2C and 3C would also not relieve Fenton, where the dense development may warrant immediate sewerage construction, although septic tank malfunctions have been rather isolated there.

Plans providing phased sewer service could be implemented somewhat sooner than the full service schemes, although no conclusive evidence is available to prove or disprove this assumption. Rather, it is based on a judgement of the response of the Chenango Valley area voters. These plans (2C and 3C) may be more quickly implemented because the chances for local approval are greater. This is because the areas voicing the strongest desire for sewer service (such as Nimmonsburg and the Town of Chenango business area) would comprise a higher percent of the initial service

area. Voters outside the initial service area should not strongly object as long as they know they will not pay for sewering until they receive the service. In summary then, plans providing phased sewering would service northern Dickinson and southern Chenango sooner than the full scale sewering plans, but would result in longer delays for service in Chenango Bridge and Fenton.

Other differences are associated with the costs to those who initially connect to a sewer collection system. An initially limited scope of sewering would require a treatment plant with a reduced economy of scale and thereby result in higher treatment charges, until 1982, to those who initially connect. Additionally, certain facilities (e.g., the outfall and portions of the regional collection system) would be designed for full sewering, but would initially be financed by those in the first phase service limits.

INSTITUTIONAL ARRANGEMENTS

For each action plan there were two alternative institutional arrangements investigated. The development of these schemes is discussed in Chapter VI and the Institutional Analysis Appendix.

The Baseline Plan would continue with the existing arrangements and institutions responsible for wastewater management. Plans 2 and 3 could be implemented by either Minor Modifications to the Existing Institutions or by an Expanded Broome County Sewer District for the Binghamton-Johnson City service area. The first arrangement would require the least change and the existing institutions would maintain jurisdictional control over their service areas. The modifications mainly involved suggestions to help obtain Federal grants and to improve the decision-making process for the Binghamton-Johnson City service area. The Expanded Broome County Sewer District would unify control and management of wastewater systems for the Binghamton-Johnson City service area (and Chenango Valley for Plans 2A and 3A). Wastewater management for this service area would become a county function rather than the responsibility of the City of Binghamton and Village of Johnson City. The institutions in the other service areas would retain their jurisdiction and would incorporate most of the suggestions (for compliance with grant application requirements) of the

Minor Modifications scheme. The Expanded County District would be more difficult to implement than the Minor Modifications arrangement as it requires changing the existing institutional structure for the Binghamton-Johnson City service area. The Expanded County District would, however, provide more uniformity by integrating wastewater management in the most complex service area.

Implementation and management of Plan 4 could be accomplished by either County Sewer Departments or a Bicounty Sewer Authority. In the former, wastewater collection and treatment systems would be managed by one sewer department for each county. In the latter, one authority would be responsible for wastewater management in both counties. These institutions would both require major departures from the existing arrangement. The expense and committment of AWT systems, however, would require the regional management approach provided by these schemes.

A major difference between the Bicounty Authority and the County Departments is that the financing of the Departments would not be "self-contained." That is, the County Department could receive funds from sources such as the general county property tax in addition to user fees. The operating expenses of the Authority would only be supported by user fees from those serviced by treatment plants.

The creation of County Departments would require a referendum with the approval of the City of Binghamton voters and the approval of the majority of towns and villages. An enactment of the State legislature would be necessary to create the Bicounty Authority. The process of creating an authority would not be easy as, in New York State, there is considerable distrust of large semi-autonomous agencies and a considerable amount of politicing at the State level would be encountered.

In summary, the process of establishing a Bicounty Sewer Authority would be more difficult than that required for County Sewer Departments, but the Authority would have the advantage of more stream-lined decision-making.

COSTS

A comparison of the capital, operation and maintenance, replacement costs, and total costs for each plan is presented in Table VIII-1. The projected local, State, and Federal cost sharing for these plans is illustrated in Figure VIII-2.

Differences among the three regionalization schemes (labelled A, B, and C) for Plans 2 and 3 were not significant in terms of either the total cost or the local share. By adding nitrification at Binghamton-Johnson City, Plan 3 would be somewhat more expensive than Plan 2: increases of 60 percent and 50 percent, respectively, over the total cost of the Baseline Plan (No. 1) and 30 percent and 25 percent, respectively, over the local cost share of the Baseline Plan. The cost of providing advanced waste treatment in Plan 4 would be almost three times the total Baseline cost and more than double the local cost of the Baseline.

SENSITIVITY OF THE PLANS

The sensitivity of the relative rankings among the plans to alternate futures and unanticipated conditions are discussed in this section. The following alternate futures were considered: various interest rates, new wastewater flow projections, demand for STP discharges below the Route 81 River Park (for subregional alternatives), necessity for the aerated storage at the Chenango Valley pump station (for regionalization alternatives) and the availability of Federal and State grants. Unanticipated conditions refer more to the engineering analyses of this Study and are primarily involved in the possibility of STP failure and the determination of the capacity and performance of the Binghamton-Johnson City treatment plant.

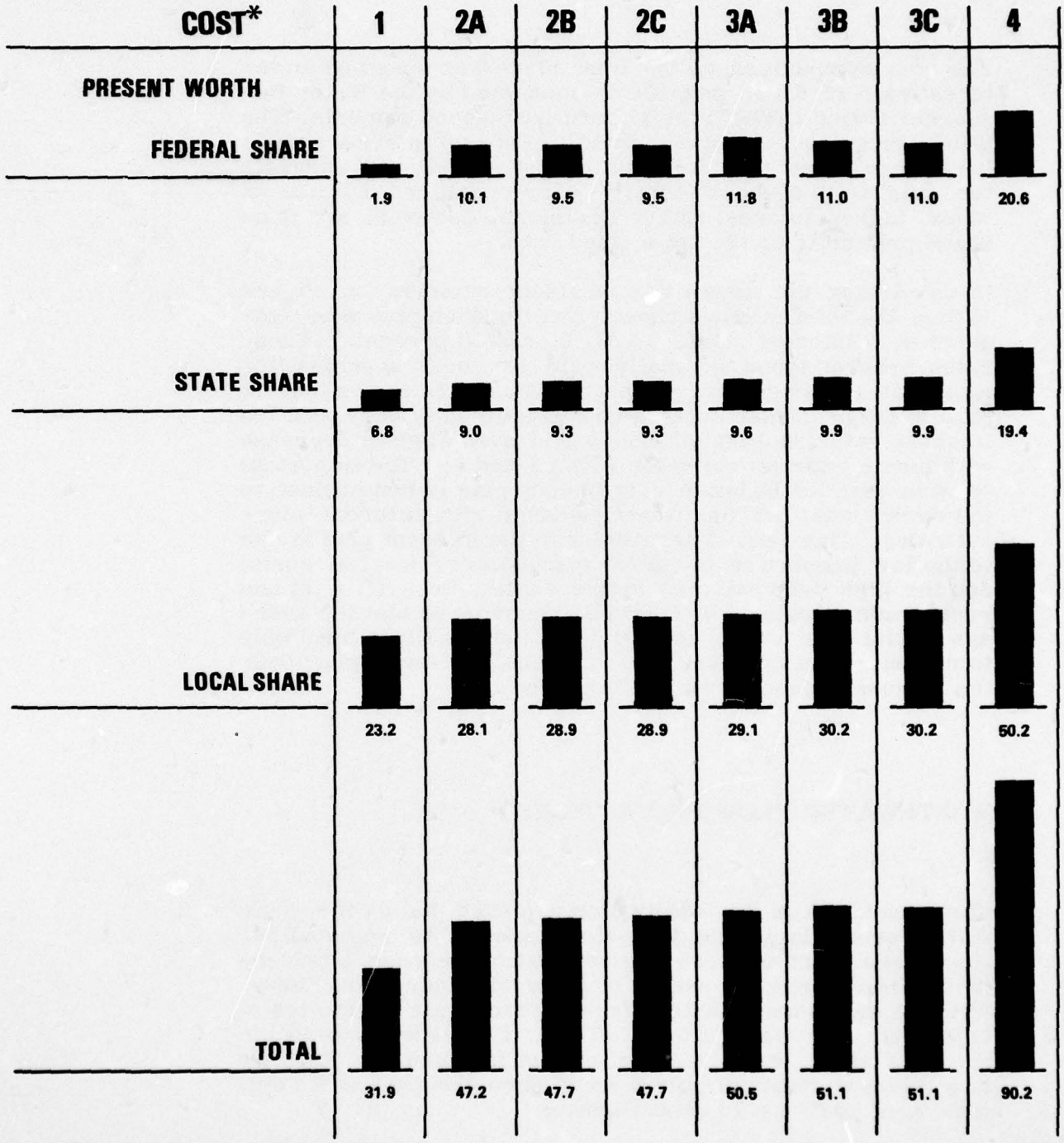
TABLE VIII-1

FINAL PLANS COST SUMMARY
(Million $'s)

Cost [1]	1	2A	2B	2C	3A	3B	3C	4
PRESENT WORTH								
Capital	2.6	13.5	12.6	12.6	15.8	14.8	14.8	27.5
O & M	19.5	22.1	23.2	23.2	22.9	24.1	24.1	48.4
Replacement	9.8	11.6	11.9	11.9	11.8	12.2	12.2	14.3
TOTAL	31.9	47.2	47.7	47.7	50.5	51.1	51.1	90.2
AVERAGE ANNUAL	2.1	3.0	3.1	3.1	3.3	3.3	3.3	5.8

[1] 6 1/8% interest and 50 year project life.

FIGURE VIII-2 COMPARISON OF FEDERAL, STATE AND LOCAL COSTS FOR FINAL PLANS



* Cost figures assume 6 1/8% interest and 50 year economic. Cost apportionment was assumed as follows:

a) Construction- 75% Federal; 12½% State, 12½% Local

b) O & M- 33% State; 67% Local

c) Replacement- 100% Local

SENSITIVITY OF AVERAGE ANNUAL COST TO INTEREST RATE

The cost comparison of the final plans was based on an interest rate of 6 1/8 percent as mandated by the Water Resources Council (WRC) for Federally financed projects. The WRC recognizes, however, that the Federal interest rate is lower than rates paid for free market capital, and suggests the sensitivity of the cost analysis be examined by use of other, higher interest rates. Decisions, however, are to be based primarily on the prescribed rate.

In developing the sensitivity analysis depicted on Figure VIII-3, the total average annual cost for each plan was computed at 3 interest rates, 6 1/8, 8, and 10 percent. These rates bracket those normally paid by local agencies for wastewater management projects. The figure shows that the total average annual costs do not significantly vary with the interest rate for Plans 2 and 3 and even slightly decrease with higher interest rates for Plans 1 and 4. The important point is that the relative cost of each plan in comparison to the others does not significantly change with different interest rates. This lack of sensitivity to the interest rate is due to the low proportion of initial expenditures (capital costs) and the high proportion of future expenditures (O & M and replacement costs). It must be remembered that the average annual cost is not an actual cost per se but is used only to measure and compare the total costs of each plan over the 50 year economic life of the project.

WASTEWATER FLOW PROJECTIONS

The economics of regionalization are such that as the waste flows become large, so does the tendency to regionalize. High flows point towards regionalization because interceptors exhibit large economies of scale with increasing flows, whereas treatment plants offer only moderate economies of scale with increasing flows. Thus, if flows were to double beyond a given level, the unit cost of transporting that flow to a regional treatment plant would drop greatly and the unit treatment costs would drop slightly.

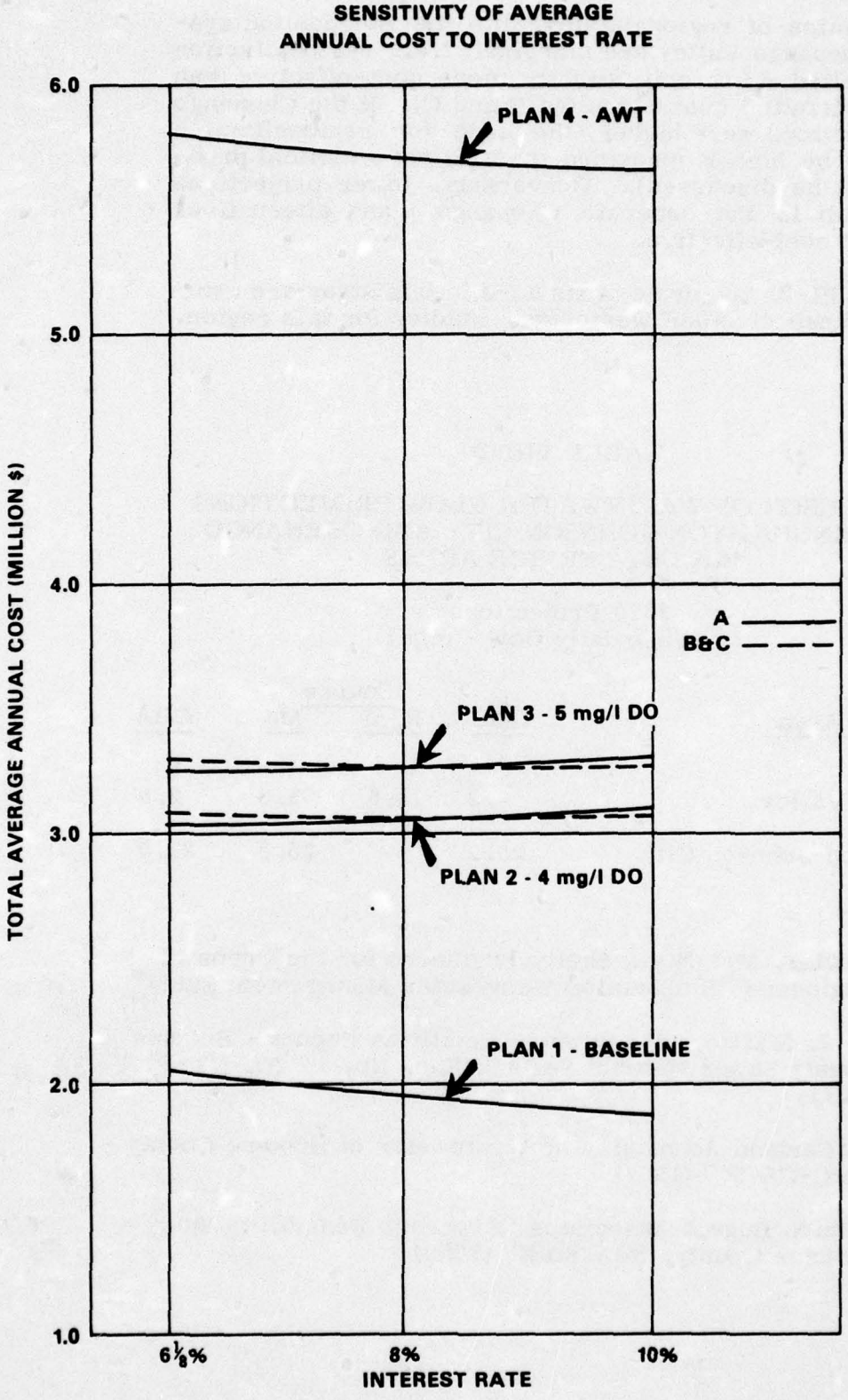


FIGURE VIII-3

The economics of regionalization into the Binghamton system for Chenango Valley are marginal, i.e., regionalization (plans labelled A) is only slightly more cost-effective than subregionalization (plans labelled B and C). If the Chenango flow projections were higher, the case for regionalization would also be higher (provided space is not a critical problem as will be discussed). Conversely, lower projections would result in the separate Chenango plant alternatives being most cost-effective.

In Table VIII-2, the projections used in this study are compared to those of other wastewater studies for this region.

TABLE VIII-2

COMPARISON OF WASTEWATER FLOW PROJECTIONS FOR BINGHAMTON-JOHNSON CITY AND CHENANGO VALLEY SERVICE AREAS

2020 Projections
(average daily flow - mgd)

Service Area	Source LMS	RJM	MJ	CBA
Chenango Valley	2.2	3.6	5.8	2.8
Binghamton-Johnson City	25.2		26.3	25.0

Sources

LMS Lawler, Matusky & Skelly Engineers for the Corps of Engineers "Binghamton Wastewater Management Study"

RJM R. J. Martin, "Wastewater Facilities Report - Broome County Sewer District Service Eng. No. 1-"PL-NY-790" (1971)

MJ McFarland-Johnson "The Wastewater of Broome County - WPC-CS-56" (1967)

CBA Clinton Bogert Associates "Sewerage Feasibility Study - Broome County, New York" (1969)

DISCHARGE BELOW THE ROUTE 81 RIVER PARK

As now proposed in this Study, the Chenango STP would discharge its wastes above the Route I-81 River Park. However, pressure from various groups may result in the outfall being located below the park when or after the facility is actually built. Plans have already been proposed (R. J. Martin Consulting Engineers, 1975) to locate the outfall below the park. The added cost of the long outfall would be $700,000 over the amount currently estimated to build the plant. This expense would result in regionalization of Chenango Valley into the B-JC system becoming significantly more cost-effective than subregionalization.

CHENANGO VALLEY PUMP STATION

Aerated storage is included in the Chenango Valley pump station for regionalization plans (Plans 2A, 3A, and 4) in order to store Chenango Valley sewage during stormwater surcharging periods in the Binghamton-Johnson City sewer system. The reason for the aerated storage is to ensure that Chenango wastes would receive secondary treatment under all conditions. Without the storage, some waste would receive only the equivalent of primary treatment at the proposed stormwater overflow facilities in the City of Binghamton.

The regionalization plans, as presently designed, provide 10 hours of storage of year 2020 peak flows for an additional cost of $700,000. If storage were provided for 10 hours of only average flows (year 2020), the cost would be negligible (on the order of $50,000). The reason for the negligible increase is that the cost of the average flow storage would be balanced by the savings in the force main size since storage would also equalize the daily flows in the main.

If a regionalization plan were implemented providing for average flows, a chance would exist that the peak flow storage would not be provided and increased overflows would occur in the Binghamton system. However, the large expenditure necessary for peak flow storage may not be justifiable when compared to the amount of pollutants prevented from entering the river.

Therefore, without the 10-hour peak storage requirement (savings of $700,000), regionalization of Chenango Valley into the B-JC system would be significantly more cost effective than subregionalization.

AVAILABILITY OF CONSTRUCTION GRANTS

The availability of construction grants should be a major factor in plan selection. The analysis has assumed full State and Federal funding for all plans. However, funding is limited by the State priority system, as discussed in the Institutional Analysis Appendix. Given the existing priority formula, the AWT system (Plan 4) would have the least chance to obtain funds. Plan 2 is the most cost-effective plan meeting water quality standards and would have the highest chance of receiving full funding.

SEWAGE TREATMENT PLANT FAILURE

Failures at sewage treatment plants hopefully will never occur. However, the impacts of partial or complete plant breakdowns should be evaluated for each plan. Relative to the Chenango Valley regionalization comparison, the possible plant failure scenarios would be:

1. A potential failure of the Chenango Valley STP resulting in a discharge of up to 2.2 mgd of raw sewage to the Chenango River and/or a potential failure of the Binghamton-Johnson City STP resulting in a discharge of 22 to 24 mgd of raw waste to the Susquehanna River (for Plans labelled B and C); or

2. A potential failure of a regional Binghamton-Johnson City STP discharging 24 to 26 mgd of raw sewage to the Susquehanna River with no potential raw sewage discharges to the Chenango River (for Plans labelled A).

Thus, regionalization would have a possibility of raw waste discharge to the Chenango River and regionalization would

entail possible discharges 10 percent higher than subregionalization to the Susquehanna River, but with no potential raw sewage discharges to the Chenango.

BINGHAMTON-JOHNSON CITY STP

Much of the analysis of the regionalization-subregionalization issue was based on the investigation into the plant performance and potential for plant expansion at the Binghamton-Johnson City STP. Two critical conclusions of the analysis were:

1. The plant can be expanded to the capacity indicated by the projections, but space problems will arise in such expansions, i.e., would be somewhat more severe in the regionalization case than in subregionalization.

2. The year in which nitrification would be needed to maintain a minimum daily average DO of 5 mg/l is not dependent on whether or not the Chenango Valley area is regionalized to the Binghamton-Johnson City system.

The first point is important because unforeseen expansion conditions (due to higher flows than projected) would result in regionalization plans having higher than expected costs. The Binghamton-Johnson City STP site is limited in space for expansion of the aeration and clarifier units.

Average flows of about 26 mgd appear to be a break point for expanding the plant. The projections used in this Study indicate the regionalization schemes would result in flows to the plant on the order of 26 mgd. If future flows are higher than projected and expansion of the plant beyond 26 mgd if more difficult than estimated, then providing a separate subregional plant at Chenango Valley would be more cost-effective.

The sensitivity regarding the year required for the installation of the nitrification units (Plan 3) has some impact on the plans. Based on the water quality model, the conclusion was that nitrification would be needed in 1994 for both regionalization and subregionalization plans. However, the higher effluent load from the Binghamton-Johnson City STP in a regional system theoretically should result in nitrification being required sooner than in the subregionalization

case. If regionalization does influence the year in which nitrification must be added, then the costs for Plans 2A and 3A would be increased. A monitoring program could better define this question.

EVALUATION CRITERIA AND SYSTEM OF ACCOUNTS

As discussed in Chapter III, the Principles and Standards require the achievement of two National objectives: National Economic Development (NED) and Environmental Quality (EQ). All plans have been measured by a system of accounts: the two objectives, NED and EQ plus Regional Development (RD) and Social Well Being (SWB). Using these four public information accounts, the beneficial and adverse impacts of each plan are displayed in Table VIII-3.

In addition to the system of accounts, a number of other criteria were applied to provide a basis for selecting a plan. These evaluation criteria considered the acceptability, certainty, completeness, effectiveness, efficiency, geographic scope, reversibility, and stability of each plan as summarized below.

PUBLIC ACCEPTABILITY

Public acceptance of each of the action plans was to some degree assured by the continuous involvement of the Citizens Advisory Committee and local and regional agency participation in the planning process. Plan 2C would likely be the most acceptable as it represents the least departure from existing conditions while maintaining good water quality. Plan 2 could be upgraded to the treatment levels provided in Plan 3 and Plan 4 as public awareness of the value of water as a resource increases. Because of the current concern for good water quality, Plan 1 would not likely be publicly desirable when future wastewater flows overload treatment plants (and also septic systems in Chenango Valley) resulting in health hazards and violations in stream standards.

PLAN 1 BASELINE

PLAN DESCRIPTION

1. Secondary Treatment at all STP's by 1977
2. No Expansions to maintain secondary thereafter
3. STP's (existing): Broome Co. - 2; Tioga Co. - 3
4. No sewering for Chenango Valley
5. No infiltration control
6. No combined sewer overflow management
7. Existing sludge management
8. Existing institutions

ACCOUNTS	WITHIN THE STUDY AREA	WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA	
NATIONAL ECONOMIC DEVELOPMENT									
		STATE							
A. Beneficial Impacts								2A	2B, 2C
B. Adverse Impacts									
1. Capital Costs – Present Worth in $Millions	0.4	0.3 (state) (Total = 2.6)	1.9	1	5	7	9	1.7	1.6
2. Operation and Maintenance – Present Worth in $Millions – 50 Years @ 6 1/8%	13.0	6.5 (state) (Total = 19.5)	–	2,3	5	7	9	14.8	15.5
3. Replacement – Present Worth in $Millions Repl. after 27 years	9.8	–	–	3	5	7	9	11.6	11.9
4. Total Present Worth in $Millions 50 years @ 6 1/8%	23.2	6.8 (Total = 31.9)	1.9	1,2,3	5	7	9	28.1	28.9
5. Average Annual Cost – $Millions 50 years @ 6 1/8%	1.5	0.4 (Total = 2.1)	0.2	1,2,3	5	7	9	1.8	1.9

Index of footnotes:

Timing

1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty

4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

2

TABLE VIII-3
SYSTEM OF ACCOUNTS

PLAN 2 SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 1 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA		WITHIN THE REGION		WITHIN THE REST OF THE NATION		TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
				STATE									
				2A	2B, 2C	2A	2B, 2C	2A	2B, 2C				
1	5	7	9	1.7	1.6	1.7 (Total = 13.5 - 2A; 12.6 - 2B, 2C)	1.6	10.1	9.4	1	5	7	9
2,3	5	7	9	14.8	15.5	7.3 (Total = 22.1 - 2A; 23.2 - 2B, 2C)	7.7	–	–	2,3	5	7	9
3	5	7	9	11.6	11.9	–	–	–	–	3	5	7	9
1,2,3	5	7	9	28.1	28.9	9.0 (Total = 47.2 - 2A; 47.7 - 2B, 2C)	9.3	10.1	9.5	1,2,3	5	7	9
1,2,3	5	7	9	1.8	1.9	0.6 (Total = 3.0 - 2A; 3.1 - 2B, 2C)	0.6	0.6	0.6	1,2,3	5	7	9

PLAN 3 IMPROVED SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary; nitrification at B-JC by 1994
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

WITHIN THE STUDY AREA		WITHIN THE REGION		WITHIN THE REST OF THE NATION		TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
STATE									
3A	3B, 3C	3A	3B, 3C	3A	3B, 3C				
2.0	1.8	2.0 (Total = 15.8 - 3A; 14.8 - 3B, 3C)	1.8	11.8	11.1	1	5		
15.3	16.1	7.6 (Total = 22.9 - 3A; 24.1 - 3B, 3C)	8.0	–	–	2,3	5		
11.8	12.2	–	–	–	–	3	5		
29.1	30.2	9.6 (Total = 50.5 - 3A; 51.1 - 3B, 3C)	9.9	11.8	11.0	1,2,3	5		
1.9	2.0	0.6 (Total = 3.3 - 3A, B, C)	0.6	0.8	0.7	1,2,3	5		

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

2

3

II-3
ACCOUNTS

PLAN 3 IMPROVED SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary; nitrification at B-JC by 1994
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA	WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
			STATE					
		3A 3B, 3C	3A 3B, 3C	3A 3B, 3C				
7	9	2.0 1.8	2.0 1.8 (Total = 15.8 - 3A; 14.8 - 3B, 3C)	11.8 11.1	1	5	7	9
7	9	15.3 16.1	7.6 8.0 (Total = 22.9 - 3A; 24.1 - 3B, 3C)	– –	2,3	5	7	9
7	9	11.8 12.2	– –	– –	3	5	7	9
7	9	29.1 30.2	9.6 9.9 (Total = 50.5 - 3A; 51.1 - 3B, 3C)	11.8 11.0	1,2,3	5	7	9
7	9	1.9 2.0	0.6 0.6 (Total = 3.3 - 3A, B, C)	0.8 0.7	1,2,3	5	7	9

PLAN 4 AWT

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. For all STP's: Nitrification by 1983 and AWT by 1985
3. STP's: Broome Co. - 2; Tioga Co. - 2
4. Chenango Valley wastes to B-JC STP and Owego Village wastes to Town of Owego STP #1
5. Infiltration Control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microstrainers and chlorination
7. Land application of liquid sludge
8. Institutions: County Departments or Bicounty Authority

EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA	WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
			STATE					
7	9	3.4	3.4 (Total = 27.5)	28.6	1	5	7	9
7	9	32.3	16.1 (Total = 48.4)	–	2,3	5	7	9
7	9	14.3	–	–	3	5	7	9
7	9	50.2	19.4 (Total = 98.2)	28.6	1,2,3	5	7	9
7	9	3.2	1.3 (Total = 5.8)	1.3	1,2,3	5	7	9

PLAN 1 BASELINE

PLAN DESCRIPTION

1. Secondary Treatment at all STP's by 1977
2. No Expansions to maintain secondary thereafter
3. STP's (existing): Broome Co. - 2; Tioga Co. - 3
4. No sewering for Chenango Valley
5. No infiltration control
6. No combined sewer overflow management
7. Existing sludge management
8. Existing institutions

ACCOUNTS	WITHIN THE STUDY AREA	WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA	
ENVIRONMENTAL QUALITY									
		@ State Line	@ Chesapeake Bay					2A	2B, 2C
A. Environmental Quality Enhanced									
1. Dissolved Oxygen – Susquehanna River MA-7-CD-10 Flow – mg/l	3-4	–	–	2,3	5		9	4-5	4-5
Design Storm – mg/l	3-4	–	–	2,3	5		9	4-5	4-5
2. BOD – Susquehanna River – 10^3 lb/day	9-14	1.3	0	2,3	5		9	5-7	6-8
3. NOD – Susquehanna River – 10^3 lb/day	17-28	9.6	0	2,3	5		9	16-27	17-30
4. TSS – Susquehanna River – 10^3 lb/day	12	12	12	2,3	5		9	12	12
5. Total N – Susquehanna River – 10^3 lb/day	7	7	13	2,3	5		9	6	6
6. Total P – Susquehanna River – 10^3 lb/day	2	2	2.2	2,3	5		9	2	2
7. NH_3 at Minimum DO in Susquehanna R. – mg/l	1.74	–	–	2,3	5		9	1.69	1.69
8. Land Required for Sludge Application, Non-consumptive Use of Agricultural Land – Acres	–	–	–					1800	1800
B. Environmental Quality Degraded									
1. Number of Major Stream Crossings	1	–	–	1	5		9	2	2
2. Miles of Regional Interceptors through Undisturbed Areas	4	–	–	1	5		9	8.3	6.8
C Environmental Quality Destroyed or Resources Consumed									
1. Acreage for new STP	0	0	0					0	5
2. Acreage for Sludge Storage Sites	0	0	0					7	7
3. Acreage for Storm Overflow Facilities in Binghamton	0	0	0					6	6
4. Electricity – KW hr/yr	11.2×10^6	0.75% of Bi-county Total Consumption	–	2,3	5		9	11.5×10^6	11.5×10^6
5. Chlorine – tons/yr	271	–	–	2,3	5		9	282	282
6. Lime – tons/yr	800-1200	Agric. Use in Bicounty is 107,000	Insignificant	2,3	5		9	840-1260	840-1260
7. Activated Carbon – tons/yr	0	0	0					0	0
8. Methanol – tons/yr	0	0	0					0	0
9. Coagulants									
Alum – tons/yr	0	0	0					0	0
Polymers – tons/yr	0	0	0					0	0
10. Fuel – gal/yr	14,000	<0.01% of Bi-county Vehicle Consumption	Insignificant	2,3	5		9	15,000	15,000

Index of footnotes:

Timing

1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty

4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

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BINGHAMTON WASTEWATER MANAGEMENT STUDY. PLAN FORMULATION APPEND--ETC(U)
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TABLE VIII-3
SYSTEM OF ACCOUNTS

2

PLAN 2 SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 1 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA		WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
				2A	2B, 2C	@State Line 2A, B, C	@Chesapeake Bay 2A, B, C				
2,3	5		9	4-5	4-5	Slight Effect	No Effect	2,3	5		9
2,3	5		9	4-5	4-5	Slight Effect	No Effect	2,3	5		9
2,3	5		9	5-7	6-8	1.1	0	2,3	5		9
2,3	5		9	19-27	17-30	9	9	2,3	5		9
2,3	5		9	12	12	12	12	2,3	5		9
2,3	5		9	8	8	8	8	2,3	5		9
2,3	5		9	2	2	2	2	2,3	5		9
2,3	5		9	1.88	1.88	Slight Effect	No Effect	2,3	5		9
				1800	1800	Comparison: 800,000 total acres in Broome-Tioga Co's.	Insignificant	2,3	5		9
1	5		9	2	2	Insignificant	Insignificant	1	5		9
1	5		9	8.3	6.8	Insignificant	Insignificant	1	5		9
				0	5	Insignificant	Insignificant	1,2,3	5		9
				7	7	Insignificant	Insignificant	1,2,3	5		9
				6	6	Insignificant	Insignificant	1,2,3	5		9
2,3	5		9	11.5×10^6	11.5×10^6	0.77% of Bi-county Total Consumption	Insignificant	2,3	5		9
2,3	5		9	282	282	Insignificant	Insignificant	2,3	5		9
2,3	5		9	848-1268	848-1268	Agric. use in Bicounty is 107,000	Insignificant	2,3	5		9
				0	0	0	0				
				0	0	0	0				
				0	0	0	0				
				0	0	0	0				
2,3	5		9	15,000	15,000	<0.01% of Bi-county Vehicle Consumption	Insignificant	2,3	5		9

PLAN 3 IMPROVED SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary; nitrification at B-JC by 1984
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

WITHIN THE STUDY AREA		WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
3A	3B, 3C	@State Line 3A, B, C	@Chesapeake Bay 3A, B, C				
5-6	5-6	Slight Effect	No Effect	2,3	5		9
4-5	4-5	Slight Effect	No Effect	2,3	5		9
4-6	5	1.0	0	2,3	5		9
13-25	11-18	5.6	0	2,3	5		9
7	7	7	7	2,3	5		9
7	7	7	14	2,3	5		9
2	2	2	2.3	2,3	5		9
0.94	0.94	Slight Effect	No Effect	2,3	5		9
1800	1800	Comparison: 800,000 total acres in Broome - Tioga Co's	Insignificant	2,3	5		9
2	2	Insignificant	Insignificant	1	5		9
8.3	6.8	Insignificant	Insignificant	1	5		9
0	5	Insignificant	Insignificant	1,2,3	5		9
7	7	Insignificant	Insignificant	1,2,3	5		9
6	6	Insignificant	Insignificant	1,2,3	5		9
16×10^6	16×10^6	1.07% of Bi-county Total Consumption	Insignificant	2,3	5		9
287	287	Insignificant	Insignificant	2,3	5		9
848-1268	848-1268	Agric. use in Bicounty is 107,000	Insignificant	2,3	5		9
0	0	0	0				
0	0	0	0				
0	0	0	0				
0	0	0	0				
15,000	15,000	<0.01% of Bi-county Vehicle Consumption	Insignificant	2,3	5		9

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

3

OUNTS

2

3

PLAN 3 IMPROVED SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary; nitrification at B-JC by 1994
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA		WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
		3A	3B, 3C	@State Line 3A, B, C	@Chesapeake Bay 3A, B, C				
	9	5-6	5-6	Slight Effect	No Effect	2,3	5		9
	9	4-5	4-5	Slight Effect	No Effect	2,3	5		9
	9	4-6	5	1.0	0	2,3	5		9
	9	13-25	11-18	5.6	0	2,3	5		9
	9	7	7	7	7	2,3	5		9
	9	7	7	7	14	2,3	5		9
	9	2	2	2	2.3	2,3	5		9
	9	0.94	0.94	Slight Effect	No Effect	2,3	5		9
	9	1800	1800	Comparison: 800,000 total acres in Broome - Tioga Co's	Insignificant	2,3	5		9
	9	2	2	Insignificant	Insignificant	1	5		9
	9	8.3	6.8	Insignificant	Insignificant	1	5		9
	9	0	5	Insignificant	Insignificant	1,2,3	5		9
	9	7	7	Insignificant	Insignificant	1,2,3	5		9
	9	6	6	Insignificant	Insignificant	1,2,3	5		9
	9	16×10^6	16×10^6	1.07% of Bi-county Total Consumption	Insignificant	2,3	5		9
	9	267	267	Insignificant	Insignificant	2,3	5		9
	9	840-1260	840-1260	Agric. use in Bicounty is 107,000	Insignificant	2,3	5		9
		0	0	0	0				
		0	0	0	0				
		0	0	0	0				
		0	0	0	0				
	9	15,000	15,000	<0.01% of Bi-county Vehicle Consumption	Insignificant	2,3	5		9

PLAN 4 AWT

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. For all STP's: Nitrification by 1983 and AWT by 1985
3. STP's: Broome Co. - 2; Tioga Co. - 2
4. Chenango Valley wastes to B-JC STP and Owego Village wastes to Town of Owego STP #1
5. Infiltration Control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microstrainers and chlorination
7. Land application of liquid sludge
8. Institutions: County Departments or Bicounty Authority

EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA	WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
			@State Line	@Chesapeake Bay				
	9	6-7	Slight Effect	No Effect	2,3	5		9
	9	5-6	Slight Effect	No Effect	2,3	5		9
	9	1	0.7	0	2,3	5		9
	9	1	0	0	2,3	5		9
	9	1	1	1	2,3	5		9
	9	1	1	1	2,3	5		9
	9	0	–	–	2,3	5		9
	9	0.15	Slight Effect	No Effect	2,3	5		9
	9	2800	Comparison: 800,000 Total Acres in Broome-Tioga Co's	Insignificant	2,3	5		9
	9	2	Insignificant	Insignificant	1	5		9
	9	9.2	Insignificant	Insignificant	1	5		9
	9	0	0	0	–	–		–
	9	16	Insignificant	Insignificant	1,2,3	5		9
	9	6	Insignificant	Insignificant	1,2,3	5		9
	9	20×10^6	1.33% of Bi-county Total Consumption	Insignificant	2,3	5		9
	9	147	Slightly beneficial compared to Baseline	Insignificant	2,3	5		9
	9	1380-2070	Agric. use in Bi-county is 107,000	Insignificant	2,3	5		9
		120	Insignificant	Insignificant	2,3	5		9
		3570	Slightly Adverse to region	Insignificant	2,3	5		9
		10,400	Slightly Adverse	Slightly Adverse	2,3	5		9
		65	Slightly Adverse	Insignificant	2,3	5		9
	9	160,000	0.11% of Bi-county Vehicle Consumption	Slightly Adverse	2,3	5		9

PLAN 1 BASELINE

PLAN DESCRIPTION

1. Secondary Treatment at all STP's by 1977
2. No Expansions to maintain secondary thereafter
3. STP's (existing): Broome Co. - 2; Tioga Co. - 3
4. No sewering for Chenango Valley
5. No infiltration control
6. No combined sewer overflow management
7. Existing sludge management
8. Existing institutions

ACCOUNTS	WITHIN THE STUDY AREA	WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA	
REGIONAL DEVELOPMENT		STATE						2A	2B, 2C
A. Beneficial Impacts									
1. Desirable Population Distribution									
a. Results in Locally or Regionally Desired Development Patterns	May or May Not	May or May Not	No Impact	1,2,3	5		9	Yes	Yes
2. Quantity of Increased Employment									
a. Manpower Requirements	59	No Impact	No Impact	1,2,3	5	7	9	66	73
B. Adverse Impacts									
1. Average Annual Cost – $Millions	1.5	0.4	0.2	1,2,3	5	7	9	1.9	1.9
2. Per Capita Average Annual Cost – Local Share (All costs in addition to current costs)									
a. Binghamton-Johnson City Service Area – $/yr	3.70	–	–	1,2,3	5	7	9	4.20	4.30
b. Chenango Valley Service Area – $/yr	–	–	–					4.20	6.00
c. Endicott Service Area – $/yr	4.10	–	–	1,2,3	5	7	9	4.60	4.60
d. East Owego (#2) Service Area – $/yr	6.00	–	–	1,2,3	5	7	9	6.70	6.70
e. West Owego (#1) Service Area – $/yr	7.70	–	–	1,2,3	5	7	9	8.10	8.10
f. Owego Village Service Area – $/yr	12.90	–	–	1,2,3	5	7	9	14.80	14.80

Index of footnotes:

Timing

1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty

4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

TABLE VIII-3
SYSTEM OF ACCOUNTS

SELINE

PTION

STP's by 1977
secondary thereafter
Co. - 2; Tioga Co. - 3
Valley

ew management
nt

PLAN 2 SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 1 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

PLAN 3 IMPROVED SEC

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary; nitrification at B-J
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Inter STP; 2B - new Chenango V. STP; 2C - Phased Chenang with initially reduced service area
5. Infiltration control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microscreen
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

THE OF TION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA		WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA		WITHIN THE REGION	WITHIN THE REST OF THE NATION
					2A	2B, 2C	STATE 2A, B, C	2A, B, C					3A	3B, 3C	STATE 3A, B, C	3A, B, C
ast	1,2,3	5		9	Yes	Yes	Yes	No Impact	1,2,3	5		9	Yes	Yes	Yes	No Impact
ast	1,2,3	5	7	9	66	73	No Impact	No Impact	1,2,3	5	7	9	66	71	No Impact	No Impact
L2	1,2,3	5	7	9	1.8	1.9	0.6	0.6	1,2,3	5	7	9	1.9	2.0	0.6 0.6	3A 3B, C 0.8 0.7
-	1,2,3	5	7	9	4.20	4.30	–	–	1,2,3	5	7	9	4.40	4.60	–	–
-					4.20	6.00	–	–	1,2,3	5	7	9	4.40	6.00	–	–
-	1,2,3	5	7	9	4.60	4.60	–	–	1,2,3	5	7	9	4.60	4.60	–	–
-	1,2,3	5	7	9	6.70	6.70	–	–	1,2,3	5	7	9	6.70	6.70	–	–
-	1,2,3	5	7	9	8.10	8.10	–	–	1,2,3	5	7	9	8.10	8.10	–	–
-	1,2,3	5	7	9	14.80	14.80	–	–	1,2,3	5	7	9	14.80	14.80	–	–

monetized in NED

fully monetized

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

2

3

UNTS

PLAN 3 IMPROVED SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary; nitrification at B-JC by 1984
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

ACTUALITY	WITHIN THE STUDY AREA		WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
	3A	3B, 3C	STATE 3A, B, C	3A, B, C				
9	Yes	Yes	Yes	No Impact	1,2,3	5		9
9	66	71	No Impact	No Impact	1,2,3	5	7	9
9	1.9	2.0	0.6 0.6	3A 3B, C 0.8 0.7	1,2,3	5	7	9
9	4.40	4.60	–	–	1,2,3	5	7	9
9	4.40	6.60	–	–	1,2,3	5	7	9
9	4.60	4.60	–	–	1,2,3	5	7	9
9	6.70	6.70	–	–	1,2,3	5	7	9
9	8.10	8.10	–	–	1,2,3	5	7	9
9	14.80	14.80	–	–	1,2,3	5	7	9

PLAN 4 AWT

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. For all STP's: Nitrification by 1983 and AWT by 1985
3. STP's: Broome Co. - 2; Tioga Co. - 2
4. Chenango Valley wastes to B-JC STP and Owego Village wastes to Town of Owego STP #1
5. Infiltration Control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microstrainers and chlorination
7. Land application of liquid sludge
8. Institutions: County Departments or Bicounty Authority

WITHIN THE STUDY AREA	WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
	STATE					
Yes	Yes	No Impact	1,2,3	5		9
121	Slight Impact	No Impact	1,2,3	5	7	9
3.2	1.3	1.3	1,2,3	5	7	9
9.50	–	–	1,2,3	5	7	9
9.50	–	–	1,2,3	5	7	9
9.10	–	–	1,2,3	5	7	9
13.20	–	–	1,2,3	5	7	9
23.80	–	–	1,2,3	5	7	9
23.80	–	–	1,2,3	5	7	9

PLAN 1 BASELINE

PLAN DESCRIPTION

1. Secondary Treatment at all STP's by 1977
2. No Expansions to maintain secondary thereafter
3. STP's (existing): Broome Co. - 2; Tioga Co. - 3
4. No sewering for Chenango Valley
5. No infiltration control
6. No combined sewer overflow management
7. Existing sludge management
8. Existing institutions

ACCOUNTS	WITHIN THE STUDY AREA	WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY	WITHIN THE STUDY AREA	
SOCIAL WELL BEING									
			STATE					2A	2B, 2C
A. Beneficial Impacts									
1. Enhancement of Health, Safety and Community Well-Being									
a. Total Coliform, Susquehanna River MA-7-CD-10 Flow – MPN/100 ml	<1,000	Complies with State Standard for swimming	Complies with Federal Standards	2,3	5		9	350	350
b. Total Coliform, Susquehanna River Design Storm – MPN/100 ml	240,000	Violates State Standards for all classes	Violates Federal Standards	2,3	5		9	1,000	1,000
2. Educational, Cultural and Recreation Opportunities									
a. Improvement to Fishing and Secondary Contact Recreation Potentials	None	None	None	2,3	5		9	Slight	Slight
b. Improvement to Primary Water Contact Recreation Potential	None	None	None	2,3	5		9	Moderate	Moderate
B. Adverse Impacts									
1. Deterioration in Quality of Life, Health and Safety									
a. Contravene Air Quality Standards	No	No	No	2,3	5		9	No	No
2. Degraded Educational, Cultural and Recreational Opportunities									
a. Recreational Sites Disturbed	0	0	0	1	5		9	2	2
b. Archaeological Resources Disturbed	No Known Impacts	No Known Impacts	No Known Inpacts	1	4		9	No Known Impacts	
c. Historical Sites Disturbed	None	None	None	1	5		9	None	None
3. Injurious Displacement of People and Community Disruption									
a. Number of Families Displaced	0	0	0	1	5		9	0	0
b. Miles of Regional Interceptors along Previously Disturbed Lands (roads, railroads)	4.5	–	–	1	5		9	6.8	6.8

Index of footnotes:

Timing

1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty

4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

TABLE VIII-3
SYSTEM OF ACCOUNTS

2

PLAN 2 SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 1 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

ACTUALITY	WITHIN THE STUDY AREA		WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
	2A	2B, 2C	STATE 2A, B, C	2A, B, C				
9	350	350	Complies with State Standard for swimming	Complies with Federal Standards	2,3	5		9
9	1,000	1,000	Complies with State Standard for swimming	Complies with Federal Standards	2,3	5		9
9	Slight	Slight	Slight	Insignificant	2,3	5		9
9	Moderate	Moderate	Slight	Insignificant	2,3	5		11
9	No	No	No	No	2,3	5		9
9	2	2	No Impact	No Impact	1	5		9
9	No Known Impacts		No Known Impacts	No Known Impacts	1	4		9
9	None	None	None	None	1	5		9
9	0	0	0	0	1	5		9
9	6.8	5.9	–	–	1	5		9

PLAN 3 IMPROVED SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary; nitrification at B-JC by 1994
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

ACTUALITY	WITHIN THE STUDY AREA		WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
	3A	3B, 3C	STATE 3A, B, C	3A, B, C				
9	350	350	Complies with State Standard for swimming	Complies with Federal Standards	2,3	5		9
9	1,000	1,000	Complies with State Standard for swimming	Complies with Federal Standards	2,3	5		9
9	Moderate	Moderate	Slight	Expected to meet fishable/swimmable criteria	2,3	5		9
9	Moderate	Moderate	Slight	Expected to meet fishable/swimmable criteria	2,3	5		9
9	No	No	No	No	2,3	5		9
9	2	2	No Impact	No Impact	1	5		9
9	No Known Impacts		No Known Impacts	No Known Impacts	1	4		9
9	None	None	None	None	1	5		9
9	0	0	0	0	1	5		9
9	6.8	5.9	–	–	1	5		9

will occur with implementation.
it will occur only when specific
tions are carried out during
ation.
it will not occur because necessary
tions are lacking.

2

3

UNTS

PLAN 3 IMPROVED SECONDARY

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. Expansions to maintain secondary; nitrification at B-JC by 1994
3. STP's: Broome Co. - 2 or 3; Tioga Co. - 3
4. Treatment of Chenango Valley wastes: Plan 2A - Interceptor to B-JC STP; 2B - new Chenango V. STP; 2C - Phased Chenango V. STP with initially reduced service area
5. Infiltration control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microscreens and chlorination
7. Land application of liquid sludge
8. Institutions: Modified or Expanded District

ACTUALITY	WITHIN THE STUDY AREA		WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
	3A	3B, 3C	STATE 3A, B, C	3A, B, C				
9	350	350	Complies with State Standard for swimming	Complies with Federal Standards	2,3	5		9
9	1,000	1,000	Complies with State Standard for swimming	Complies with Federal Standards	2,3	5		9
9	Moderate	Moderate	Slight	Expected to meet fishable/swimmable criteria	2,3	5		9
11	Moderate	Moderate	Slight	Expected to meet fishable/swimmable criteria	2,3	5		9
9	No	No	No	No	2,3	5		9
9	2	2	No Impact	No Impact	1	5		9
9	No Known Impacts		No Known Impacts	No Known Impacts	1	4		9
9	None	None	None	None	1	5		9
9	0	0	0	0	1	5		9
9	6.8	5.9	–	–	1	5		9

PLAN 4 AWT

PLAN DESCRIPTION

1. Secondary treatment at all STP's by 1977
2. For all STP's: Nitrification by 1983 and AWT by 1985
3. STP's: Broome Co. - 2; Tioga Co. - 2
4. Chenango Valley wastes to B-JC STP and Owego Village wastes to Town of Owego STP #1
5. Infiltration Control: 3 mgd in Binghamton
6. Combined sewer overflow treatment using microstrainers and chlorination
7. Land application of liquid sludge
8. Institutions: County Departments or Bicounty Authority

ACTUALITY	WITHIN THE STUDY AREA	WITHIN THE REGION	WITHIN THE REST OF THE NATION	TIMING	UNCERTAINTY	EXCLUSIVITY	ACTUALITY
		STATE					
9	350	Complies with State Standard for swimming	Complies with Federal Standards	2,3	5		9
9	1,000	Complies with State Standard for swimming	Complies with Federal Standards	2,3	5		9
9	Moderate	Slight	Expected to meet fishable/swimmable criteria	2,3	5		9
9	Moderate	Slight	Expected to meet fishable/swimmable criteria	2,3	5		9
9	No	No	No	2,3	5		9
9	2	No Impact	No Impact	1	5		9
9	No Known Impacts	No Known Impacts	No Known Impacts	1	4		9
9	None	None	None	1	5		9
9	0	0	0	1	5		9
9	7.7	–	–	1	5		9

Plans labelled "C", providing an initially reduced service area for Chenango Valley, would likely be more acceptable to Chenango Valley voters (than Plans B or C) as the areas most in need of and voicing the strongest desire for sewering comprise a higher percentage of the initial service area.

CERTAINTY OF ACHIEVING PLANNING OBJECTIVES

Each of the four Plans for Choice was evaluated on the basis of achieving the program requirements and goals of Public Law 92-500 and the water quality standards and stream classifications designated by the New York State Department of Environmental Conservation.

For P. L. 92-500, program goals and requirements have been designated for three benchmark years - 1977, 1983, and 1985. By 1977 and thereafter, all publicly owned STP's must achieve secondary treatment. The U. S. EPA has defined secondary treatment as 85 percent removal of biological oxygen demand (BOD) and 85 percent removal of suspended solids (SS). By 1983, P. L. 92-500 states that an interim goal of water quality be achieved providing for the protection and propagation of fish, shellfish, and wildlife and providing recreation in and on the water. Specific criteria for these "fishable-swimmable" waters have not yet been established by EPA, but most likely will include secondary treatment as a minimum with higher levels of treatment investigated on a case-by-case basis for specific areas. Furthermore, P. L. 92-500 states: "It is the national goal that the discharge of pollutants into navigable waters be eliminated by 1985."

In addition to the Federal requirements, the NYSDEC has certain stream classifications and water quality standards which must be achieved. Each stream has a certain classification which, in turn, carries with it certain standards for water quality. Most waters of the Susquehanna and Chenango Rivers within the Bicounty Area are classified as either Class A, B, or C waters. Class A waters are drinking waters; Class B waters are suited for primary contact recreation (swimming); and Class C waters are suited for secondary contact recreation (fishing and boating). Aside from the higher standards for Class A drinking waters, the major difference in the classes of water are the allowable limits for the bacteriological indicator of coliform. Class A waters

allow 5,000 MPN/100 ml of total coliform; Class B waters allow 2,400 MPN/100 ml of total coliform; and Class C waters allow 10,000 MPN/100 ml of total coliform. Dissolved oxygen (DO) concentration is also an important standard of the NYSDEC's water quality program. For the main stem of the Susquehanna River downstream of Rockbottom Dam and for the Chenango River, the applicable DO standard is stated as follows: "For non-trout waters, the minimum daily average shall not be less than 5.0 mg/l. At no time shall the DO concentration be less than 4.0 mg/l." This standard applies to the MA-7-CD-10 flow and all higher flows.

For the purposes of the Binghamton Wastewater Management Study, the Federal program requirements of P. L. 92-500 and the NYSDEC water quality classifications and standards were applied in the following manner. For the 1977 requirement, all STP's should achieve secondary treatment with no bacteriological violations of the stream classifications and no violations of the 4.0 mg/l instantaneous minimum DO standard. For the 1983 goal of fishable-swimmable waters, a minimum daily average DO concentration of 5.0 mg/l should be maintained in the river at all time with no bacteriological violations. And finally, advanced waste treatment would approach the "no discharge" goal established for 1985.

Using these requirements, water quality standards, and assumptions as objectives, each of the four Plans for Choice was evaluated as outlined in the following paragraphs.

PLAN 1

The Baseline Plan would not achieve the secondary treatment requirement for 1977 and thereafter. All STP's in the Bi-county Area would gradually become overloaded as sewage flows continue to increase without corresponding increases in STP capacities or efficiencies. The resulting BOD and SS loadings to the river would be high and adverse impacts would occur to the aquatic ecology of the Susquehanna River.

The minimum average DO level in the Susquehanna River would drop to 3.5 mg/l at the MA-7-CD-10 flow, and could be below the minimum instantaneous standard of 4.0 mg/l even at higher flows. Design storm conditions would

similarly degrade the bacteriological conditions of the Susquehanna and Chenango Rivers (total coliform as high as 240,000 MPN/100 ml) due to uncontrolled and untreated combined sewer overflows. The Chenango Valley area would remain unsewered, resulting in possible groundwater and surface water pollution.

Consequently, the Baseline Plan would meet none of the NYSDEC or Federal requirements for water quality.

PLAN 2

The all secondary treatment plan would meet the 1977 secondary treatment requirements. All STP's in the Urban Study Area, including the Owego Village STP, would be expanded at appropriate times to a minimum of secondary treatment throughout the planning period (2020). The resulting BOD and SS loadings to the Susquehanna River would be lower than in the Baseline Plan, although phosphorous and nitrogen loadings would be slightly higher because of the sewering of Chenango Valley.

Plan 2 would meet the Study's criteria for fishable-swimmable waters at the MA-7-CD-10 flow, at least until the mid-1990's. After 1994, the DO concentration in the Susquehanna River could occasionally drop below 5.0 mg/l, but never below 4.0 mg/l. At the 2020 sewage loading rates and the MA-7-CD-10 flow, the critical DO sag in the Susquehanna River would occur for a five mile stretch of the river between Endicott and Apalachin. The minimum daily average DO concentration would be about 4.5 mg/l at the low point. Design storm conditions would never depress the DO level below the minimum instantaneous standard. Bacteriological violations, either during the MA-7-CD-10 flow or the design storm conditions, would not occur.

Therefore, Plan 2 was evaluated as fully satisfying the 1977 requirements. Additionally, Plan 2 would meet the fishable-swimmable objective at least to the mid-1990's. Potential violations of the fishable-swimmable objective could occur after 1994; these violations, though, would be isolated in time, short in duration, and limited in distance. Consequently, Plan 2 was judged to satisfy the broad intent of the 1983 goal by providing fishable-swimmable waters during all but extreme conditions. Plan 2, however, would not achieve the 1985 "no discharge" requirement.

PLAN 3

Plan 3 would provide secondary treatment at all STP's except Binghamton-Johnson City, would have an additional nitrification process. All STP's would be expanded as required to maintain minimum secondary treatment efficiencies, and the Binghamton-Johnson City STP would be upgraded to provide nitrification by the mid-1990's. The resulting BOD and SS loadings to the Susquehanna River would be slightly lower than in either the Baseline Plan or Plan 2, with phosphorous and nitrogen loadings to the river about the same as Plan 2.

Plan 3 would meet the Study's criteria for fishable-swimmable waters above 5.0 mg/l of DO at the MA-7-CD-10 flow throughout the planning period. Design storm conditions would never depress the DO level below the minimum instantaneous standard. Bacteriological violations, either during the MA-7-CD-10 flow or the design storm conditions, would not occur.

Therefore, Plan 3 was evaluated as fully satisfying the 1983 goal for fishable-swimmable waters throughout the entire planning period. However, Plan 3 would not meet the 1985 goal of "no discharge."

PLAN 4

Plan 4 would provide nitrification in 1983 and advanced waste treatment in 1985 for strict compliance with the 1985 "no discharge" goal of P. L. 92-500 as defined by the Corps of Engineers. Plants would be expanded as required after 1985 to accommodate increasing flows and maintain the strict limits for effluent discharge. Resulting BOD, SS, phosphorous, and nitrogen loadings to the river would be minimal. Bacteriological violations of water quality classifications would not occur. Dissolved oxygen concentrations would not drop below 5.0 mg/l, either during design storm conditions or normal operation at MA-7-CD-10 flows.

Consequently, Plan 4 was evaluated as satisfying the intent of the 1985 "no discharge" goal of P. L. 92-500 as defined by the Corps of Engineers.

PLAN COMPLETENESS

The Interagency Study Management Group, comprised of the Federal, State, and regional agencies responsible for wastewater management, provided guidance on the necessary planning requirements to be achieved. Plans 2, 3, and 4 were structured to comply with New York State water quality programs and can be used as an amendment to the county comprehensive regional plans. Furthermore, these plans fulfill most, but not all, EPA requirements for Step 1, facilities planning (Section 201 of P.L. 92-500). The proposed institutional arrangements also suggest ways to help municipalities in obtaining construction grants.

EFFECTIVENESS AND TECHNICAL PERFORMANCE

Plan 4, providing AWT, represents the highest level of treatment technologically available and would be the most effective means of approaching the Corps of Engineers definition of zero discharge of pollutants. This plan would however, result in heavy resource commitments (primarily electricity, fuel, and chemicals) and adverse economic impacts. Although the water quality of the rivers would improve, no increase in the recreational use of the Susquehanna River is projected because of other limiting factors (such as access).

Plan 2, using secondary treatment, and Plan 3, secondary at all plants with nitrification added at Binghamton-Johnson City, would achieve Class B stream standards which provide for fishable-swimmable conditions. Plan 3 would provide a slight improvement in the DO level of the Susquehanna River over Plan 2 (minimum daily average DO of 5.5 mg/l compared to 4.5 mg/l during extreme low flow conditions).

The poorest technical performance would occur under the Baseline Plan. The Federal requirement of secondary treatment by 1977 as well as State standards would be violated as the treatment plants become overloaded.

EFFICIENCY

Plan 2 would be the most efficient method to achieve water quality standards and meet Study objectives at least cost. It would therefore have the highest chance of receiving full funding. Plan 3 would be the cost-effective approach should slightly higher DO levels during low flow conditions become desirable or required. Likewise, should the benefits of obtaining zero discharge of pollutants eventually outweigh the economic burden and resource committments of AWT, then Plan 4 would be the most efficient means of attaining the zero discharge objective.

GEOGRAPHIC SCOPE

Initially, the Study examined all of Broome and Tioga Counties to fully encompass and assess regional wastewater management questions and related problems. In all, 18 wastewater management areas were designated and studied as these communities were identified in the Southern Tier East Regional Plan as having a concentration of existing or expected future development. These areas were divided into the Urban Study Area and the Outlying Communities. Only general suggestions were provided for the 9 Outlying Communities as these areas were not expected to have a significant impact on water quality in the Susquehanna and Chenango Rivers. Most of the emphasis was focused on the 9 wastewater management areas comprising the Urban Study Area. The major planning effort of the Study was thus directed to those areas where the Study objectives could effectively be achieved.

REVERSIBILITY

Plan 2 would be the easiest to restore to the Baseline Condition as it would require the least modification of the existing systems and would have the least investment committed. Plan 3 would be slightly less reversible as it would

include those commitments made for Plan 2 and an additional investment in nitrification facilities. Plans 2 and 3 represent the first and second steps, respectively, to implement Plan 4 which has the highest capital investment and resource commitments. Plan 4 would therefore be the least reversible system. Plans labelled C would be more reversible than A and B as initial sewer service would be limited to a smaller portion of the Chenango Valley area. The required commitment in collection systems and treatment capacities would therefore not be as large.

STABILITY

The stability of each system was discussed in the previous section on "Sensitivity of the Plans." The following points summarize the stability of each action plan to different assumptions and unanticipated conditions.

1. The relative cost of one plan to another does not significantly change with varying interest rates.

2. Under the assumptions used in this Study, there is no significant cost difference between options A, B, and C for Plans 2 and 3. If future wastewater flows are less than those projected, plans (labelled B and C) providing a separate treatment plant for Chenango Valley would be more cost-effective than plans (labelled A) providing treatment of Chenango Valley wastewater at the Binghamton-Johnson City plant. Conversely, increases in wastewater flows above that projected would theoretically favor plans labelled A. However, the extra space required at the Binghamton-Johnson City STP may become a critical problem. If plant expansion is more difficult than estimated, then plans providing a separate treatment plant for Chenango Valley would be the cost-effective solution.

3. If the outfall from the Chenango Valley STP is to be designed to discharge below the Route 81 River Park rather than a more direct route to the Chenango River (plans labelled B and C), then regionalization of Chenango Valley with Binghamton-Johnson City (A) would be cost-effective.

4. If the storage requirement at the Chenango Valley pump station is reduced, then Plans labelled A would be cost-effective. Increased overflows may occur in the Binghamton sewer system however, for Plans 2A and 3A.

5. A monitoring program may modify the assumptions used in the water quality model, resulting in different DO levels than those projected for this Study. Higher DO levels than those currently predicted may result in the over design of treatment facilities. Plan 2 would be the most flexible as commitments would not be made for unnecessary treatment. On the other hand, if lower DO levels occur than those projected, Plan 2 would not be sufficient in meeting the objectives. However, this plan is readily amenable for upgrading to higher treatment levels as it provides the basis for both Plan 3 and 4.

REPORT ADDENDUMS

During the review procedure for the Binghamton Wastewater Management Study draft Report, three items were noted which required additional effort for the final Report. Since these additional items were specific in nature, the work has been documented in addendums to the Design and Cost Appendix and summarized in the following sections of the Plan Formulation Appendix.

The three additional work items include: (1) the development of project costs on a 20-year basis in conformance with EPA guidelines and comparison to the 50-year costs already presented in the Report; (2) the estimation of costs on a basis of a 50 percent factor for all engineering and contingencies, and comparison to the costs based on the 30 percent factor used for the main Report; and (3) preliminary design and costs for flood-proofing structures at each of the STP's. These three work items were accomplished for the Plans of Choice presented in Chapter VII.

SHORT TERM (20 YEAR) ECONOMIC ANALYSIS

The costs presented in the main body of this Report were based on a 50-year economic life. In accordance with recent EPA guidelines (Guidelines on Preparing a Facilities Plan, May 1975) and Corps of Engineers regulations (ER 1105-2-22 and ER 1105-2-180), this section presents the

costs of the final plans projected over a 20-year economic life. A comparison is then made between this short term (20 year) and long term (50 year) analyses and their effect on the relative costs of the four Plans for Choice.

To obtain the costs for the 20-year planning period, the construction and O&M schedules developed for the 50-year analysis were used for the years 1977 through 1996. As replacement costs for the long term analysis were based on a 27-year composite useful life, no replacement was assumed for the short term analysis. Costs are expressed as both present worth and average annual, computed at an interest rate of 6 1/8 percent. More information on the development of these costs is provided in Addendum A of the Design and Cost Appendix.

Table VIII-4 and Figure VIII-4 provide a cost comparison of the final plans for both the 20-year and 50-year planning periods. The relative costs of Plans 1, 2, 3, and 4 does not significantly differ between the short term planning period and the long term. For Plans labelled A, B, and C, a small change in the relative ranking is noted, however. With a 20-year economic life, plans labelled "C" are the least expensive (but only slightly), followed by "B" and "A" plans. This finding supports the ISMG recommendation of Plan 2C as the Plan of Choice.

COST SUMMARY WITH 50 PERCENT ENGINEERING AND CONTINGENCIES COSTS

Throughout the main body of the Report for the Binghamton Wastewater Management Study, a 30 percent factor for engineering and contingencies was included in the capital costs. That is, the estimated capital cost was 130 percent of the estimated construction cost. This factor was used to cover the cost of engineering design services, administrative charges, and unforeseen expenditures.

Due to the complexity of the proposed wastewater management plans and the preliminary nature of the projects investigated, it was suggested during review of the draft Report that an engineering and contingencies factor of 50 percent also be investigated. As requested, the purpose of this section is to present cost information for each of the Plans for Choice with a 50 percent engineering and contingencies

TABLE VIII-4

SUMMARY OF COSTS

20 YEAR AND 50 YEAER PROJECTIONS[1]
(MILLION $'s)

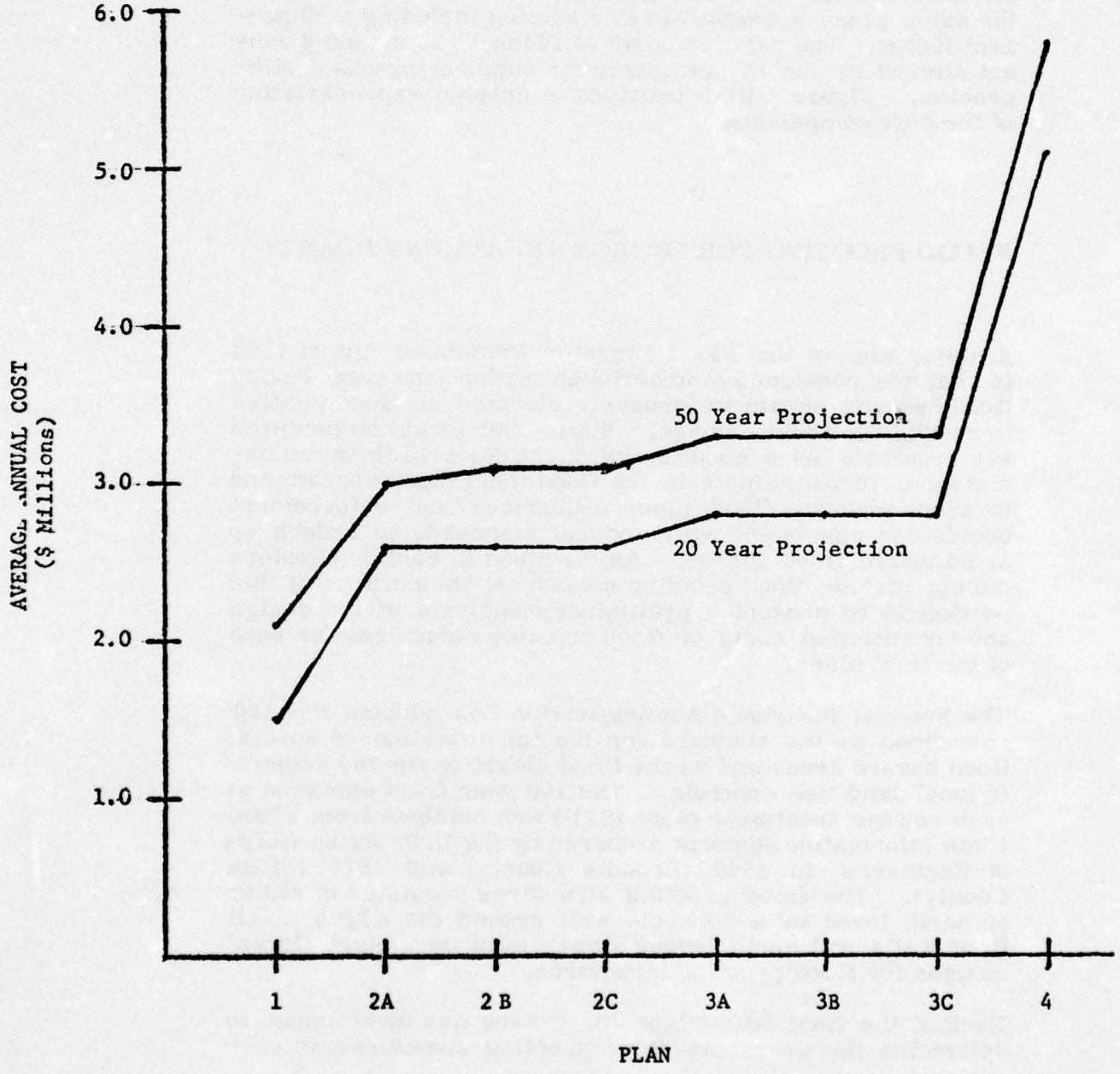
	PLAN							
	1	2A	2B	2C	3A	3B	3C	4
20-Year Economic Life								
Present Worth	17.1	29.9	29.6	29.4	32.0	31.8	31.7	58.2
Average Annual Worth	1.5	2.6	2.6	2.6	2.8	2.8	2.8	5.1
50-Year Economic Life								
Present Worth	31.9	47.2	47.7	47.7	50.5	51.1	51.1	90.2
Average Annual Worth	2.1	3.0	3.1	3.1	3.3	3.3	3.3	5.8

[1] 6 1/8 percent interest.

FIGURE VIII-4

SUMMARY OF COSTS

20 YEAR AND 50 YEAR PROJECTIONS



factor for construction costs. The methodology and cost breakdowns are more fully documented in Addendum B of the Design and Cost Appendix.

Table VIII-5 summarizes both the total present worth cost and the average annual cost for each plan with a 50 percent engineering and contingencies factor included. Table VIII-6 compares the total costs of plans developed earlier in the Report including a 30 percent factor with the total costs of the same plans presented in this section including a 50 percent factor. The relative costs of Plans 1, 2, 3, and 4 were not altered by the higher factor for engineering and contingencies. Figure VIII-5 provides a graphic representation of the cost comparison.

FLOOD PROOFING FOR SEWAGE TREATMENT PLANTS

A major aim of the Flood Disaster Protection Act of 1973 is that new construction undertaken within an area having flood hazards should be properly elevated or flood proofed to reduce or avoid damage. States and local communities are required, as a condition of future Federal financial assistance, to participate in the flood insurance program and to adopt adequate flood plain ordinances and enforcement provisions consistent with Federal standards to reduce or avoid future flood losses. As the plans in earlier chapters did not include flood proofing measures, the purpose of this section is to present a preliminary analysis of the design and construction costs of flood proofing structures for each of the final plans.

The Federal Insurance Administration has adopted the 100 year flood as the standard for the identification of special flood hazard areas and as the flood elevation for the adoption of local land use controls. The 100 year flood elevation at each sewage treatment plant (STP) was obtained from Flood Plain Information Reports prepared by the U.S. Army Corps of Engineers in 1969 (Broome County) and 1975 (Tioga County). The flood proofing structures consisted of either an earth levee or a concrete wall around the STP's. All flood walls and earth levees were based on typical Corps' designs for flood proofing structures.

Each of the final four Plans for Choice was investigated to determine the necessary flood proofing structures at each

TABLE VIII-5

FINAL PLANS COST SUMMARY

ENGINEERING AND CONTINGENCIES @ 50% [1]
(MILLION $'s)

Cost	1	2A	2B	2C	3A	3B	3C	4
PRESENT WORTH								
Capital	3.0	15.5	14.5	14.5	18.2	17.1	17.1	31.9
O & M	19.5	22.1	23.2	23.2	22.9	24.1	24.1	48.4
Replacement	9.8	11.6	11.9	11.9	11.8	12.2	12.2	14.3
TOTAL PRESENT WORTH	32.3	49.2	49.6	49.6	52.9	53.4	53.4	94.6
AVERAGE ANNUAL COST	2.1	3.2	3.2	3.2	3.4	3.5	3.5	6.1

[1] 6 1/8% Interest and 50-year Project Life.

TABLE VIII-6

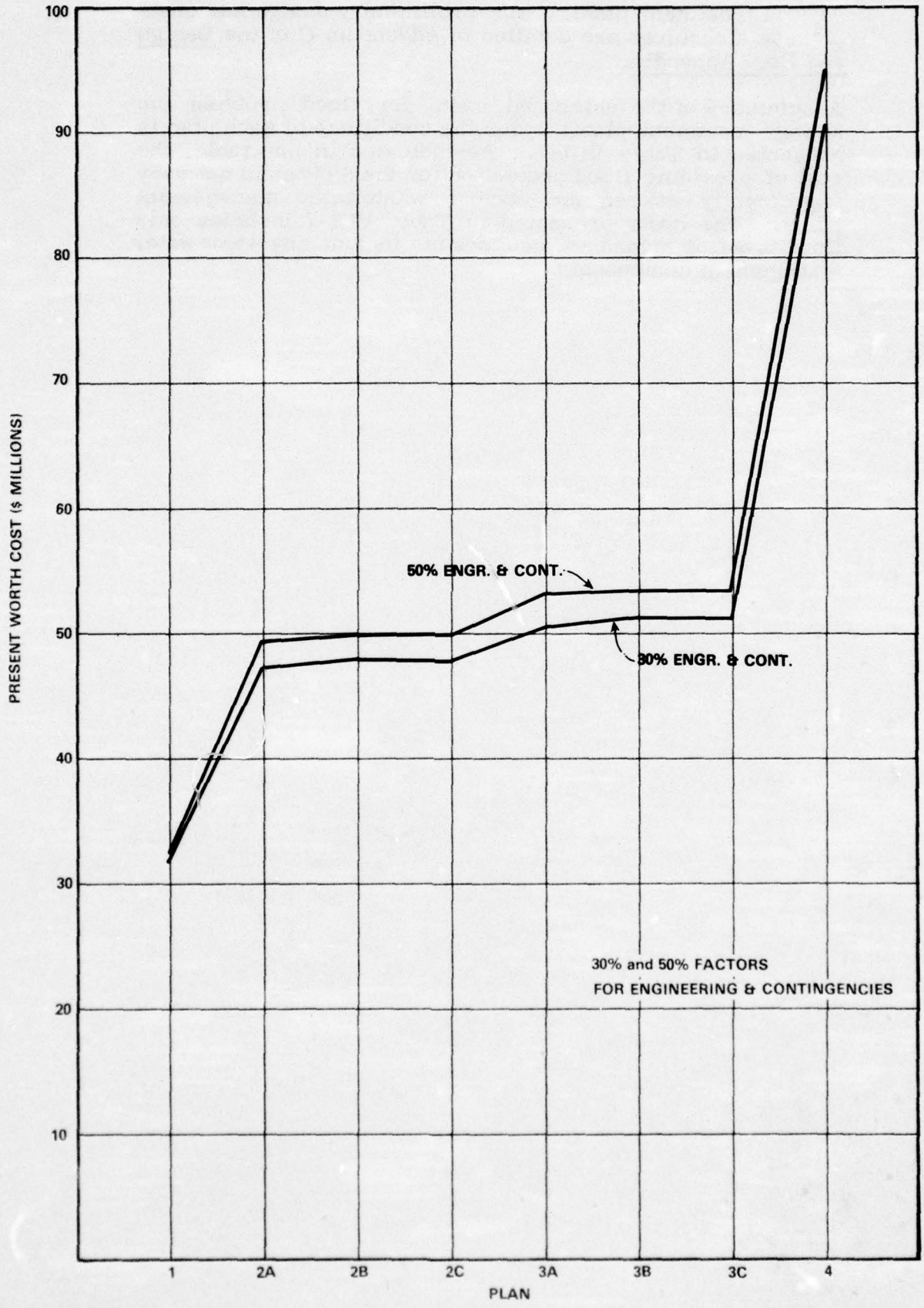
TOTAL COST COMPARISON*

30 PERCENT AND 50 PERCENT ENGINEERING
AND CONTINGENCIES FACTORS
(Million $'s)

	PLAN							
	1	2A	2B	2C	3A	3B	3C	4
30% Engineering & Contingencies								
Capital	2.6	13.5	12.6	12.6	15.8	14.8	14.8	27.5
O & M	19.5	22.1	23.2	23.2	22.9	24.1	24.1	48.4
Replacement	9.8	11.6	11.9	11.9	11.8	12.2	12.2	14.3
TOTAL	31.9	47.2	47.7	47.7	50.5	51.1	51.1	90.2
50% Engineering & Contingencies								
Capital	3.0	15.5	14.5	14.5	18.2	17.1	17.1	31.9
O & M	19.5	22.1	23.2	23.2	22.9	24.1	24.1	48.4
Replacement	9.8	11.6	11.9	11.9	11.8	12.2	12.2	14.3
TOTAL	32.3	49.2	49.6	49.6	52.9	53.4	53.4	94.6

*Present Worth, 6 1/8 percent interest, 50-year economic life.

FIGURE VIII-5. SUMMARY OF COSTS



sewage treatment plant. The preliminary design and costs of these structures are detailed in Addendum C of the Design and Cost Appendix.

A summary of the estimated costs for flood proofing the sewage treatment plants under the conditions of each plan is presented in Table VIII-7. As indicated in this table, the cost of providing flood protection for the STP's did not vary significantly between the various wastewater management plans. The costs presented in Table VIII-7 includes only flood proofing measures and does not include any wastewater management components.

TABLE VIII-7

COST OF FLOOD PROOFING STP's
($1,000)

STP	WASTEWATER MANAGEMENT PLAN							
	1	2A	2B	2C	3A	3B	3C	4
Binghamton-Johnson City	-	509	502	502	507	507	507	519
Endicott	-	1,587	1,587	1,587	1,587	1,587	1,587	1,656
Chenango Valley	-	-	212	212	-	212	212	-
Owego No. 1	-	158	158	158	158	158	158	165
Owego No. 2	-	363	363	363	363	363	363	376
Owego Village	-	461	461	461	461	461	461	-
TOTAL		3,078	3,283	3,283	3,076	3,288	3,288	2,716

April 1975 Dollars

Note: Costs in this table reflect only the costs of flood proofing.

CHAPTER IX

SUMMARY AND CONCLUSIONS

SUMMARY

The Binghamton Wastewater Management Study was a cooperative effort of Federal, State, and local participants interested in maintain good water quality for future generations living along the Susquehanna River in Broome and Tioga Counties, New York. The culmination of the two year endeavor is the Study Report documenting the findings and decisions of the Study.

The Study was accomplished in general conformance with the Principles and Standards for Planning Water and Related Land Resources. Stage I developed the Plan of Study and delineated a broad range of strategies while focusing on problem identification. Stage II formulated specific wastewater management alternatives (wastewater, stormwater, and sludge) and assessed the impacts of the various alternatives. And, finally, Stage III refined and evaluated complete plans with the goal of recommending a single "Plan of Choice." The sequential progress of the Study was discussed in this Plan Formulation Appendix, and supporting appendices describe the details of the specific work items.

Three management committees provided guidance for the Study throughout the two year period. The Interagency Study Management Group (ISMG) was the lead committee, taking into account suggestions from the other two committees for Study direction while interpreting agency policies and guidelines for wastewater management planning. The Technical Advisory Committee (TAC) had primary responsibility for checking engineering aspects of the plans. The Citizens Advisory Committee (CAC) provided a continuing "citizens" assessment and evaluation of plans as they were formulated

and refined in the iterative procedure. Through the interaction of the three committees working together, forty initial strategies were successively screened to four final plans for consideration.

CONCLUSIONS

As a result of the long months of effort and many committee meetings, a "Plan of Choice" from the four plans was recommended by the Interagency Study Management Group for consideration by local authorities for implementation (see Table IX-1). This Plan of Choice is Plan 2C described in Chapter VII and outlined in Figure IX-1.

Plan 2C proposes a secondary treatment level for six sewage treatment plants. These STP's include the existing facilities at Binghamton-Johnson City, Endicott, Owego Town #1, Owego Town #2, and Owego Village. A new plant would be constructed for the Chenango Valley area of Broome County. Sewer service in Chenango Valley would be accomplished in phases, so that the areas closest to the Chenango River with the most immediate problems could be serviced first. The existing physical system in Tioga County would remain unchanged, except for the Owego Village STP which would be upgraded to secondary treatment.

Plan 2C includes microscreening of combined sewer overflows within the City of Binghamton as well as a cost-effective level of 1 mgd infiltration control. Microscreening of overflows and inflow control were also proposed for the Village of Owego.

Sludge management for Plan 2C considers land application of liquid sludge as an attractive means of recycling potential resources. Should this system prove infeasible, landfill of dewatered sludge would be used as a backup alternative.

Implementation for all plan components (wastewater, stormwater, and sludge) could be achieved either (a) by the existing institutions with certain minor modifications to their structure in both Counties, or (b) by an expanded Broome County Sewer District with minor modifications to the Tioga County wastewater management institutions.

TABLE IX-1

FINAL PLANS

Plan No.	Description	Year 2020 DO Levels Daily Pollutant Loadings @ MA-7-CD-10 Flows: Minimum Instantaneous	Year 2020 DO Levels Daily Pollutant Loadings @ MA-7-CD-10 Flows: Minimum Daily Aver.	Number of Plants: Broome Co.	Number of Plants: Tioga Co.	Binghamton Infiltration Control (mgd)	Non-Structural Measures	Binghamton and Owego Village Storm Overflow Control	Sludge Management	Institution	Total Aver. Annual Cost** ($ million)
1	Baseline	3.0	3.5	2	3	0	None	None	Existing	Existing	2.1
2A	Secondary	3.9	4.4*	2	3	1.0	None	Microscreens & Chlorination	Land Application	Modified or District	3.0
2B	Secondary	4.0	4.5*	3	3	1.0	None	Microscreens & Chlorination	Land Application	Modified or District	3.1
2C	Secondary (Phased Service)	4.0	4.5*	3	3	1.0	None	Microscreens & Chlorination	Land Application	Modified or District	3.1
3A	Secondary plus Nitrification	4.9	5.4	2	3	3.0	None	Microscreens & Chlorination	Land Application	Modified or District	3.3
3B	Secondary plus Nitrification	5.0	5.5	3	3	3.0	None	Microscreens & Chlorination	Land Application	Modified or District	3.3
3C	Secondary plus Nitrification (Phased Service)	5.0	5.5	3	3	3.0	None	Microscreens & Chlorination	Land Application	Modified or District	3.3
4	Advanced Waste Treatment	6.2	6.7	2	2	3.0	Pricing & Education	Microscreens & Chlorination	Land Application	County Dept. or Bicounty Authority	5.8

* Contrevention of NYSDEC standard for minimum daily average DO (5 mg/l) may occur after 1994.

** Includes all capital, O&M, and replacement costs; 50 year economic life @ 6 1/8%.

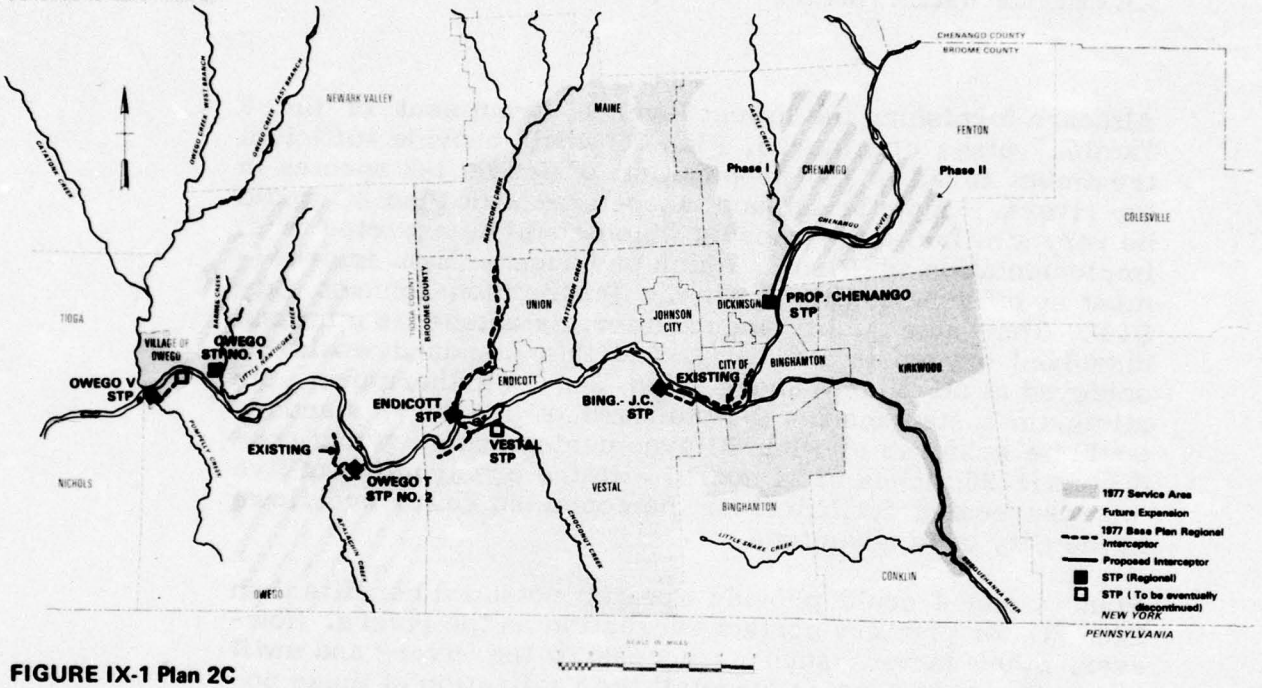


FIGURE IX-1 Plan 2C

The recommendation of Plan 2C as the Plan of Choice was the result of many discussions and the resolution of several conflicting viewpoints. The opinions and decisions leading to the recommendation of Plan 2C are highlighted in the following paragraphs.

LEVEL OF TREATMENT

Although furnishing the lowest level of treatment of the 3 "action" plans considered, Plan 2C would provide sufficient treatment to allow the propagation of native fish species in the rivers. Aquatic impacts associated with Plan 2C would be very similar to the impacts which could be expected from implementation of Plan 3, which provides a slight improvement in effluent quality from the Binghamton-Johnson City STP. The water quality standard for instantaneous minimum dissolved oxygen is 4.0 mg/l, and this standard would be achieved at all times under Plan 2C. Furthermore, the minimum instantaneous DO standard of 4.0 mg/l standard could be achieved by Plan 2C even during design storm conditions (1.25 inches in 24 hours) with the construction of five microscreening facilities for the combined sewer overflows in the City of Binghamton.

Plans 3 and 4 could provide greater potential benefits than Plan 2C for primary contact recreation on the rivers. However, other factors such as access to the rivers and swift currents would tend to forestall the realization of these potential benefits. Implementation of Plan 2C, then, would not result in less recreational activity on the river than the other plans.

Plan 2C, with secondary treatment at all plants, would lend itself readily to staged construction of additional treatment processes for higher water quality. For instance, Plan 2C would maintain minimum daily average dissolved oxygen level of 5.0 mg/l at the design low flow conditions until the mid-1990's. When higher water quality is desired at some point in the future (or is mandated by law), then new processes could be added to upgrade the secondary system. In all 630 likelihood, Plan 3 (nitrification), which was designed to reduce the oxygen-demanding waste discharged from the Binghamton-Johnson City STP, would be a first step to achieving better water quality throughout the Susquehanna River in Broome and Tioga Counties, As such, Plan 2C

would provide a logical stepping stone to any higher level of treatment, even biological based advanced waste treatment. In the meantime, secondary treatment would provide acceptable water quality while management institutions organize for higher levels of treatment as the need arises. Plan 2C, therefore, would furnish a larger degree of flexibility for achieving more stringent water quality standards on an incremental basis in a cost-effective manner.

Plan 3 was judged to have considerable merit, but the additional expenses for nitrification at the Binghamton-Johnson City STP of $3 to $4 million for construction and $150,000 per year for O & M did not appear to be economically justified when an all secondary treatment plan could achieve substantially the same results. Plan 4, a method for approaching the Corps of Engineers definition of the 1985 no discharge goal, did not generate any sustained interest because of its high economic cost, the necessity for sizable resource commitments, and the comparatively small benefits relating to improved water quality.

Secondary treatment at all plants was the least-cost system achieving water quality standards established for the Susquehanna and Chenango Rivers. Therefore, Plan 2C would have the greatest likelihood of obtaining the full share of both Federal and State grants for design, construction, and O & M. Neither organization would fund plans necessitating large expenditures for only small benefits in return. This last point is particularly important for the Bicounty Area since the region already has fairly good water quality while other areas of New York State have more pressing needs for available grant monies.

REGIONALIZATION

Broome County

Plan 2C proposes that a separate STP be built in Chenango Valley instead of sending Chenango Valley wastewater flows to the Binghamton-Johnson City STP for treatment. Comparison to plans proposing the combination of the Chenango Valley service area and the Binghamton-Johnson City service area resulted in several observations supporting separate STP's for the two areas.

Although the Binghamton-Johnson City STP was originally conceived as a regional plant to serve adjacent suburban communities including Chenango Valley, several factors have combined to raise questions about the plant's regional capacity. For instance, the Binghamton-Johnson City STP and its interceptor system probably could not handle normal wastewater flows plus wet weather flow (inflow and infiltration) plus Chenango Valley wastewater flow at one time. Wastes from Chenango Valley would require storage during storm conditions or until flow in the Binghamton system was low enough to permit the addition of wastewater flows from Chenango Valley. Without storage, Chenango Valley sanitary wastewater flow would place additional demands on the existing sewer system during storms particularly along Front Street in Binghamton, and would most likely result in the aggravation of the present combined sewer overflow problem. The ability to control inflow and infiltration which could open up additional capacity for Chenango Valley wastes in the interceptors and at the treatment plant during wet weather flow is of an uncertain nature.

At the Binghamton-Johnson City STP itself, space for expansion is at a premium. Any large increase in daily volume such as the addition of Chenango Valley flows would require supplemental facilities at the plant. This space requirement can be met, but coupled with any future upgrading to a higher level of treatment, the Binghamton-Johnson City STP site may not be able to accomodate these additional components. A further consideration is the possibility that Binghamton-Johnson City's own service area would generate more wastewater than current projections indicate. If this occurs, then any additional space at the plant site would be needed to serve the system's present users, exclusive of Chenango Valley.

In spite of the economic analysis showing that either regionalization or subregional costs are about equal from the overall economic viewpoint in Broome County, different costs would accrue to users of either system. Individual Chenango Valley residents could expect to pay more for sewage treatment if connection was made to the Binghamton-Johnson City system than if Chenango Valley constructed its own treatment plant. The reason for this difference to the Chenango Valley resident is the present billing formula employed by Binghamton-Johnson City for assessing costs against suburban connectors such as Chenango Valley. In the case of the Binghamton-Johnson City resident, however, both regionalization and subregionalization would cost about the same.

After considering the facts described above, the ISMG concurred that a separate Chenango Valley STP was in the best interest of both the Binghamton-Johnson City and Chenango Valley. By retaining its reserve capacity for its own users, the Binghamton-Johnson City STP would opt for a degree of flexibility in dealing with stormwater overflow problems, infiltration problems, additional connections from such areas as Five Mile Point, possible increases in projected wastewater flow above the current estimations, and potential treatment upgrading for a higher effluent quality at some time in the future. Chenango Valley, on the other hand, could proceed immediately toward construction of its own STP without awaiting solutions to the numerous problems in the Binghamton system.

Within the Chenango Valley, Plan 2C proposes a small, limited service area adjacent to the Chenango River serving the communities with the greatest need. Correspondingly, the initial treatment plant would also be small (1.0 mgd) to serve only the "first phase" service area. As both the need for sewer service and the wastewater flow increase, the service area and the sewage treatment plant could be expanded to meet the new demands. In this manner, "second phase" service area customers would not have to pay for sewer services until connected to the plant as needed. For this reason, Plan 2C was more acceptable than Plan 2B which proposed sewering of the entire area and construction of a larger Chenango Valley STP at the outset.

Tioga County

As in Broome County, subregionalization with three STP's (Owego Town #1, Owego Town #2, and Owego Village) is the optimum physical system in Tioga County with an all secondary level of treatment. The three plant all secondary scheme furnishes both a cost-effective and an environmentally acceptable method for achieving the desired water quality. Each of the three systems could continue to function separately, as past efforts for regionalization have not been successful. Furthermore, Plan 2C for Tioga County is exactly the same as any of the options for Plan 3, nitrification. If any future incremental upgrading of treatment levels would be required as outlined in Plan 3, modifications to existing treatment processes would most likely center around the larger plants in Broome County. Tioga County STP's would remain unaffected.

INSTITUTIONAL ARRANGEMENTS

There are two institutional arrangements recommended for the implementation of the Phased Sewering Plan: (1) Minor Modification to the Existing Institutions; and (2) Expanded Broome County Sewer District for the Binghamton-Johnson City Service Area.

Minor Modifications

The first arrangement involves modifications to the existing wastewater management institutions. This arrangement is recommended for both Broome and Tioga Counties not only because it involves the least change to existing institutions but also because it includes suggestions to help the existing institutions comply with Federal (EPA) requirements for construction grants (e.g., the use of metered rates, industrial recovery mechanisms, and so forth). Of equal importance to both counties is the fact that existing wastewater management institutions would generally be able to maintain jurisdictional control over their respective service areas.

In essence, since the capital improvements required by the Phased Sewering Plan would not be large, and the local wastewater management institutions are capable with regard to construction and operation, a minimal institutional change system would be implementable.

Expanded Broome County Sewer District

The second, or Expanded County District arrangement, pertains primarily to Broome County. Tioga County would maintain its existing wastewater management institutions with the implementation of some of the modifications suggested under the first institutional arrangement.

The expanded Broome County Sewer District would unify control over sewers for the Binghamton-Johnson City service area and for Chenango Valley. Furthermore, several of the suggestions made under the first institutional arrangement would be carried out by one governing body; a Broome County Sewer Agency.

The District arrangement was also supported because it would represent the least complicated form of institutional change necessary to integrate wastewater collection and treatment in the most complex service area, i.e., Binghamton-Johnson City. With negotiations and transfer of power to the county level as a necessary requirement, this institutional arrangement would also be implementable.

LONG RANGE PLANNING

Plan 2C furnishes a good foundation on which to build any future plans for wastewater management. On a long-term basis, Plan 2C keeps open a number of possibilities for future action - no potential opportunities are foreclosed.

In-stream water quality standards would be achieved at least to the mid-1990's with Plan 2C, and possibly longer. If higher levels of treatment are ever required, this plan lends itself easily to staged construction in either Broome County or Tioga County. For instance, nitrification at the Binghamton-Johnson City STP (Plan 3) would provide the next incremental step of water quality. Nitrification is a logical progression from Plan 2C, with only add-on unit processes necessary at the Binghamton-Johnson City STP.

Plan 2C also would lend itself to increasing levels of both infiltration control and/or stormwater control. As treatment costs increase in future years, higher volumes of infiltration control than the 1 mgd recommended in Plan 2C may become cost-effective. Implementation of control measures can then proceed on an as-needed basis in conjunction with the local economic situation. In a similar vein, stormwater microscreens can be constructed on a priority basis - the worst overflow receiving initial funding for construction, the second worst overflow receiving funds when monies are again available, and so forth.

If the highest level of water quality would be warranted eventually, then advanced waste treatment could be provided as described in Plan 4. Again, Plan 2C is a logical starting point to arriving at a biologically based AWT system.

In summation, then, Plan 2C provides a great deal of flexibility for achieving water quality standards in an incremental fashion and also for expending limited Federal and State

grant money in a rational and effective manner. Plan 2C's ability to achieve existing water quality standards without significant adverse impacts, its low cost in comparison to other plans, and its inherent flexibility for solving a variety of possible problems and changing standards were the important criteria in the ISMG's recommendation.

FINAL COORDINATION AND REPORT PREPARATION

As a result of the recommendation of Plan 2C as the Plan of Choice, the Corps of Engineers prepared its draft Report in the fall of 1975 documenting the entire Study effort. The draft Report was printed in 8 volumes including: The Public Involvement Appendix, The Background Information Appendix, The Institutional Analysis Appendix, The Impact Assessment and Evaluation Appendix, The Specialty Appendix, The Design and Cost Appendix, The Plan Formulation Appendix, and The Summary Report. The draft Report was distributed to all members of the ISMG, the CAC, the TAC, the consultants, and other interested agencies at Federal, State, and local levels. Review comments were requested from each participant.

Colonel Robert S. McGarry, District Engineer for the Baltimore District, Corps of Engineers, conducted the final public meeting on 25 November 1975. He briefly outlined the procedure used for the Study and described the final four Plans for Choice from which the ISMG made a single recommendation. The audience then divided into three smaller groups for informal workshop discussions. These workshops were conducted by the staff members of the Corps of Engineers who were assisted by CAC and TAC members. Questions and responses generally revolved around the technical details of the plans and the projected impacts, particularly those of the recommended plan. After the workshops, the three groups again convened as a large audience for formal statements by participants and a summary. Generally, meeting participants were in agreement with the work which had been accomplished during the Study.

Following the November public meeting, Colonel McGarry addressed a joint meeting of the Broome and Tioga County legislatures on 17 December 1975. The purpose of this meeting was to summarize the Study, explain the decision-making process, and describe the recommended Plan of

Choice. Questions and answers followed the formal presentation as the county legislators sought to gain a good understanding of the recommended plan. Most legislators reacted favorably to the Plan of Choice.

Based on written comments concerning the draft Report, the statements made at the public meeting, and the reactions of the county legislators, appropriate revisions were made to the draft Report as the final Report was prepared. For the final report, one additional volume was prepared to accompany the 8 initial volumes mentioned in the preceding section. This extra volume, entitled Comments Appendix, contained the written reactions to the draft Report and to the recommendations of the Study. As such, the Comments Appendix contains an evaluation of the Study effort by organizations and individuals other than the Corps of Engineers.

The nine-volume final Report is offered as a planning tool for the continuing assessment and evaluation of water quality and related resources. Implementation of measures investigated in this Report are the ultimate responsibility of local decision makers as they strive for reasonable solutions to areawide problems concerning future water resource commitments.

LIST OF ABBREVIATIONS

AAC	Average Annual Cost
AWT	Adverage Waste Treatment
BAQMA	Binghamton Air Quality Maintenance Area
BAT	Best Available Technology Currently Available
BCHD	Broome County Health Department
BCSA	Broome County Sewer Agency
B-JC	Binghamton-Johnson City
BJCJSB	Binghamton-Johnson City Joint Sewer Board
BOD	Biochemical Oxygen Demand
BPT	Best Practicable Technology Economically Achievable
BPWTT	Best Practicable Waste Treatment Technology
CAC	Citizens Advisory Committee
CFS	cubic feet per second
COD	Chemical Oxygen Demand
COE	US Army Corps of Engineers
DO	Dissolved Oxygen
DOT	Department of Transportation
EPA	Environmental Protection Agency
GPCD	gallons per capita per day
GPD	gallons per day
GPM	gallons per minute
HUD	US Department of Housing and Urban Development
ISMG	Interagency Study Management Group
LMS	Lawler, Matuskey, and Skelly Engineers
MA-7-CD-10	minimum average seven consecutive day flow occurring once in ten years
mgd	million gallons per day
mg/l	milligrams per liter
ml	mililiters
MLVSS	Mixed Liquor Volatile Suspended Solids
MPN	Most Probable Number
NOD	Nitrogenous Oxygen Demand
NPDES	National Pollutant Discharge Elimination System
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation & Maintenance
P/C	physical/chemical
POS	Plan of Study
PW	Present Worth
QLM	Quirk, Lawler, and Matusky Engineers
SCS	US Department of Agriculture Soil Conservation Service
SRBC	Susquehanna River Basin Commission
SS	Suspended Solids
STERPB	Southern Tier East Regional Planning Board
STP	Sewage Treatment Plant
SWMM	Storm Water Management Model
TAC	Technical Advisory Committee
TCCS	Tioga County Comprehensive Sewage Study
WPCP	Water Pollution Control Plant

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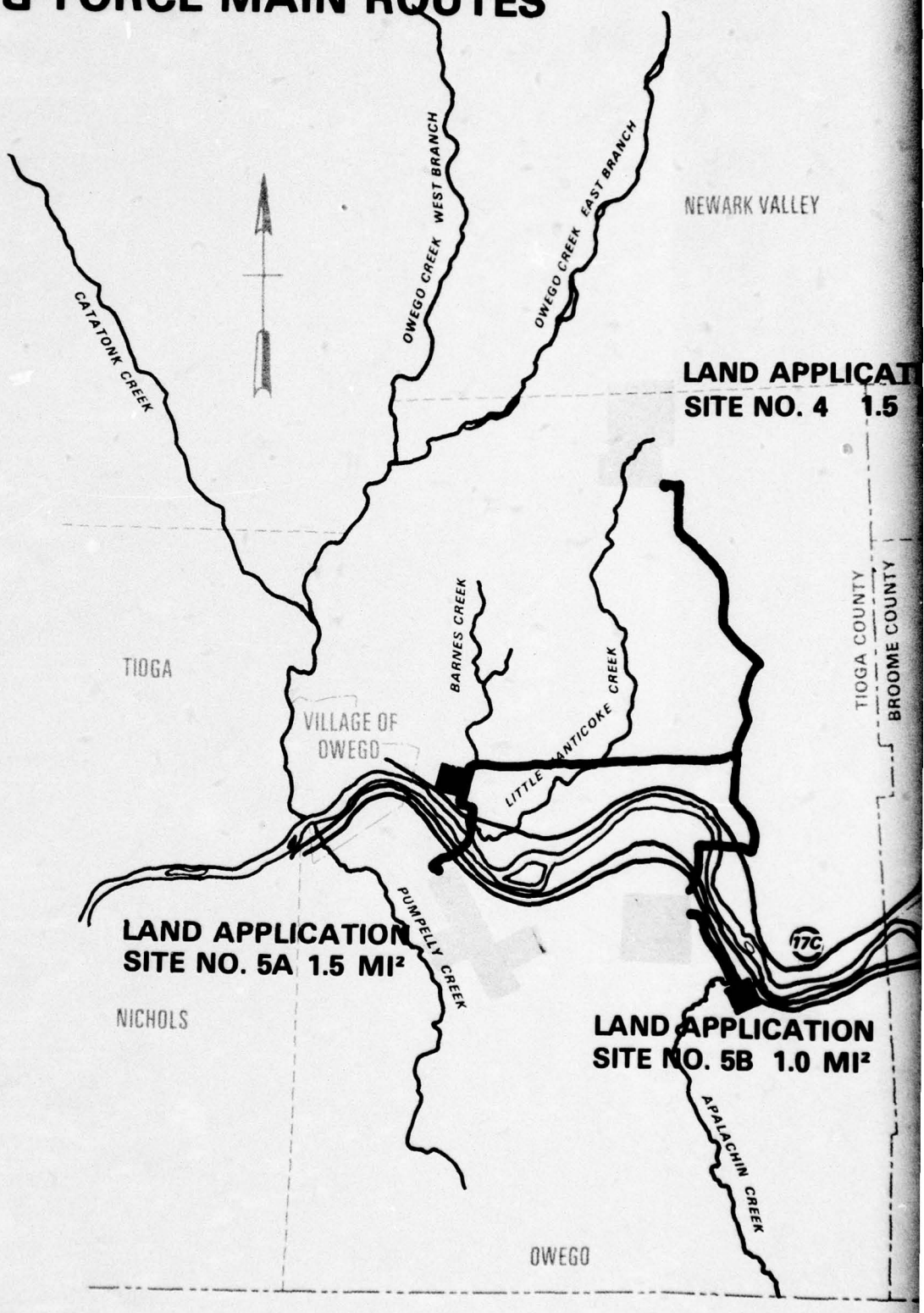
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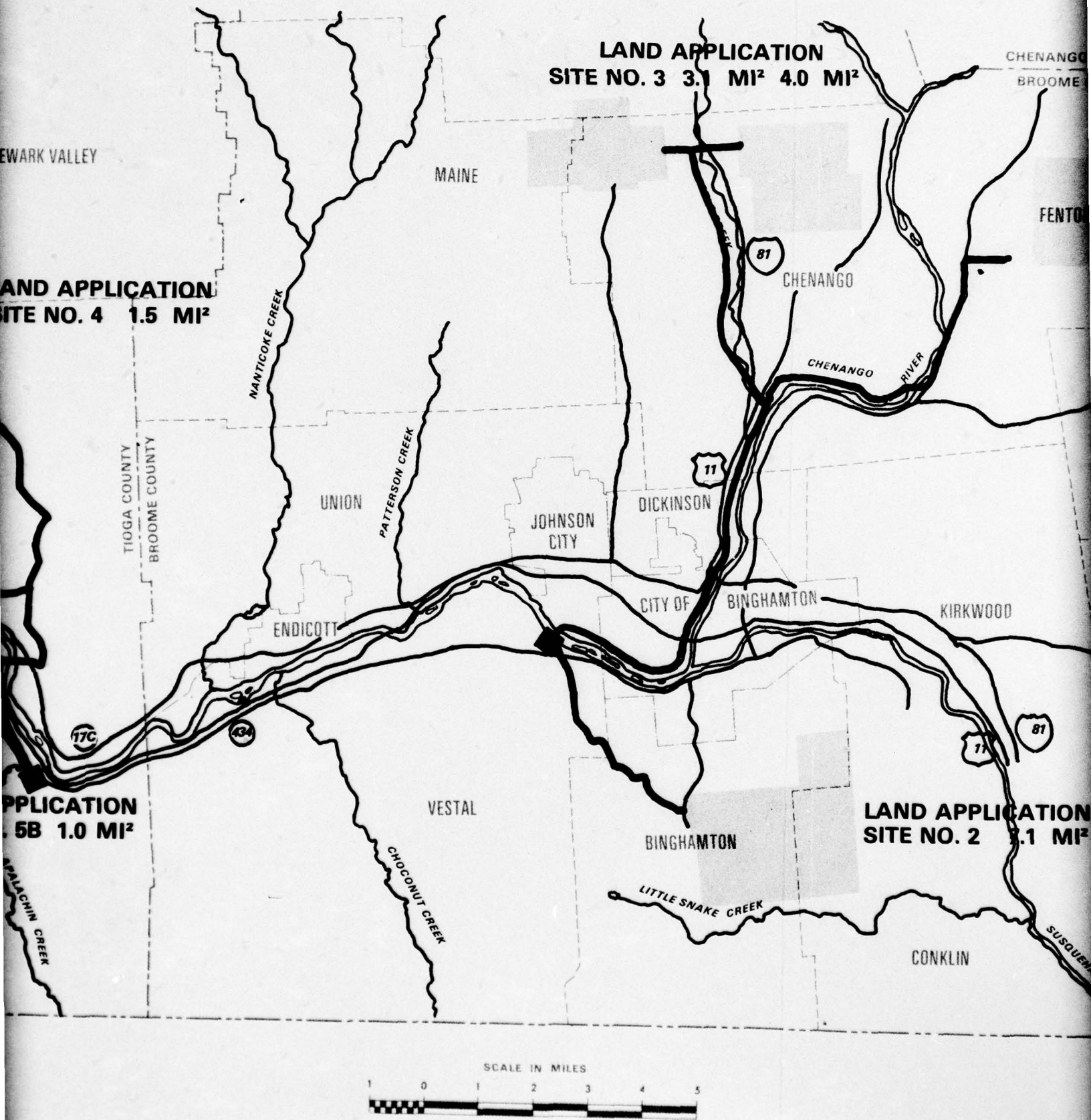
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LAND APPLICATION ALTERNATIVE SITES & FORCE MAIN ROUTES



TIVE SITES


LAND APPLICATION
SITE NO. 3 3.1 MI² 4.0 MI²
CHENANGO
BROOME
EWARK VALLEY
MAINE
FENTO
81
CHENANGO
AND APPLICATION
ITE NO. 4 1.5 MI²
NANTICOKE CREEK
CHENANGO RIVER
TIOGA COUNTY
BROOME COUNTY
PATTERSON CREEK
11
UNION
JOHNSON CITY
DICKINSON
CITY OF BINGHAMTON
KIRKWOOD
ENDICOTT
17C
434
PPLICATION
. 5B 1.0 MI²
VESTAL
BINGHAMTON
LAND APPLICATION
SITE NO. 2 3.1 MI²
CHOCONUT CREEK
LITTLE SNAKE CREEK
CONKLIN
SCALE IN MILES
1 0 1 2 3 4 5

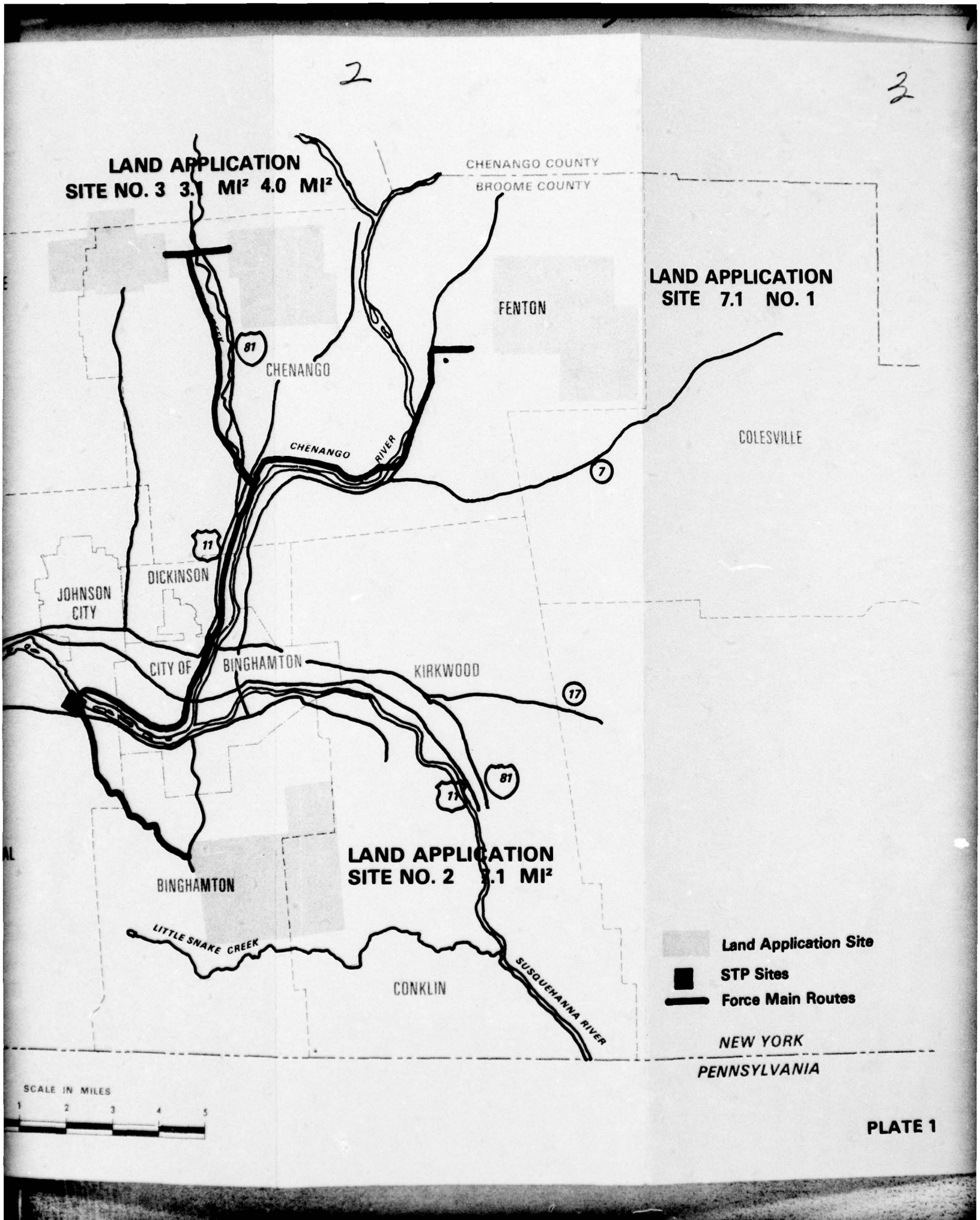
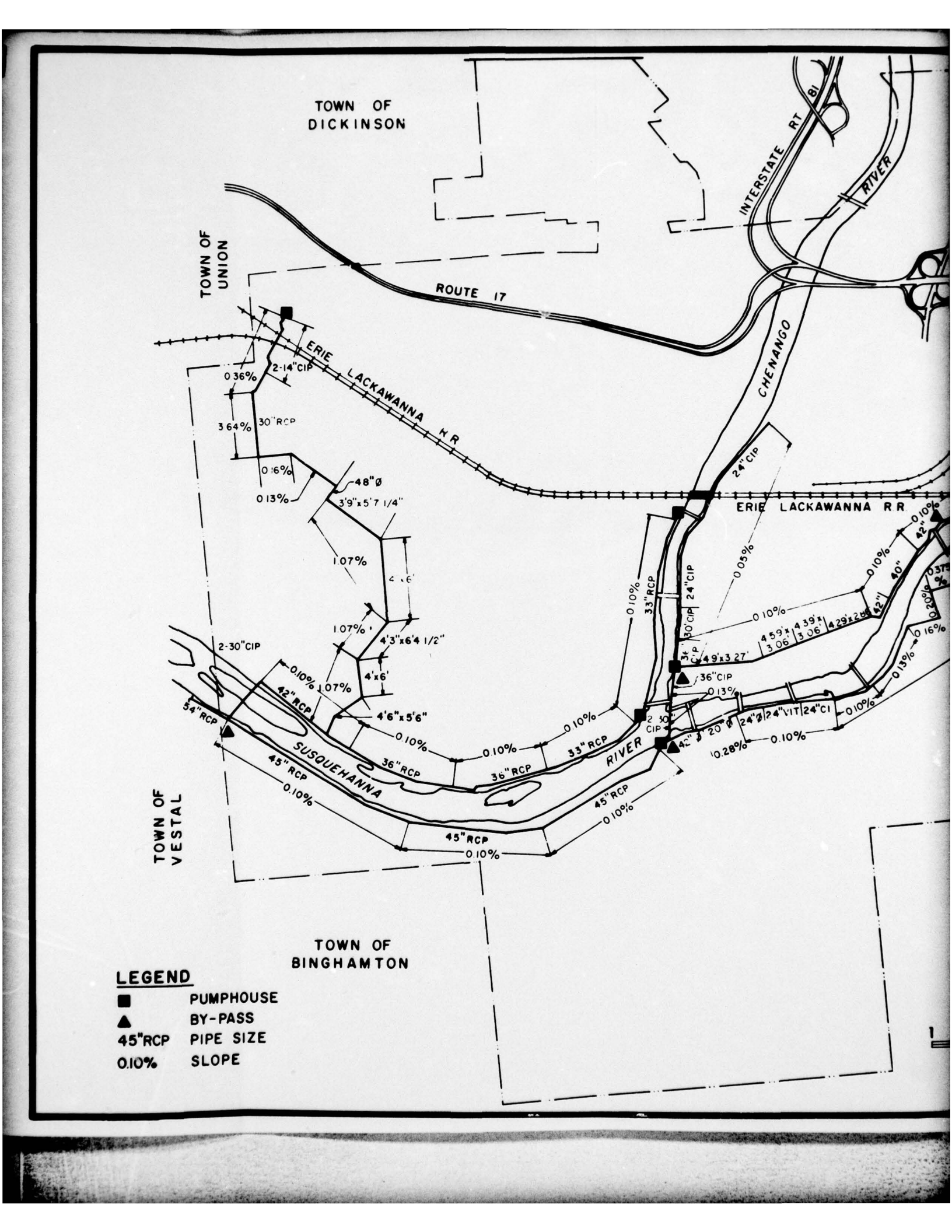
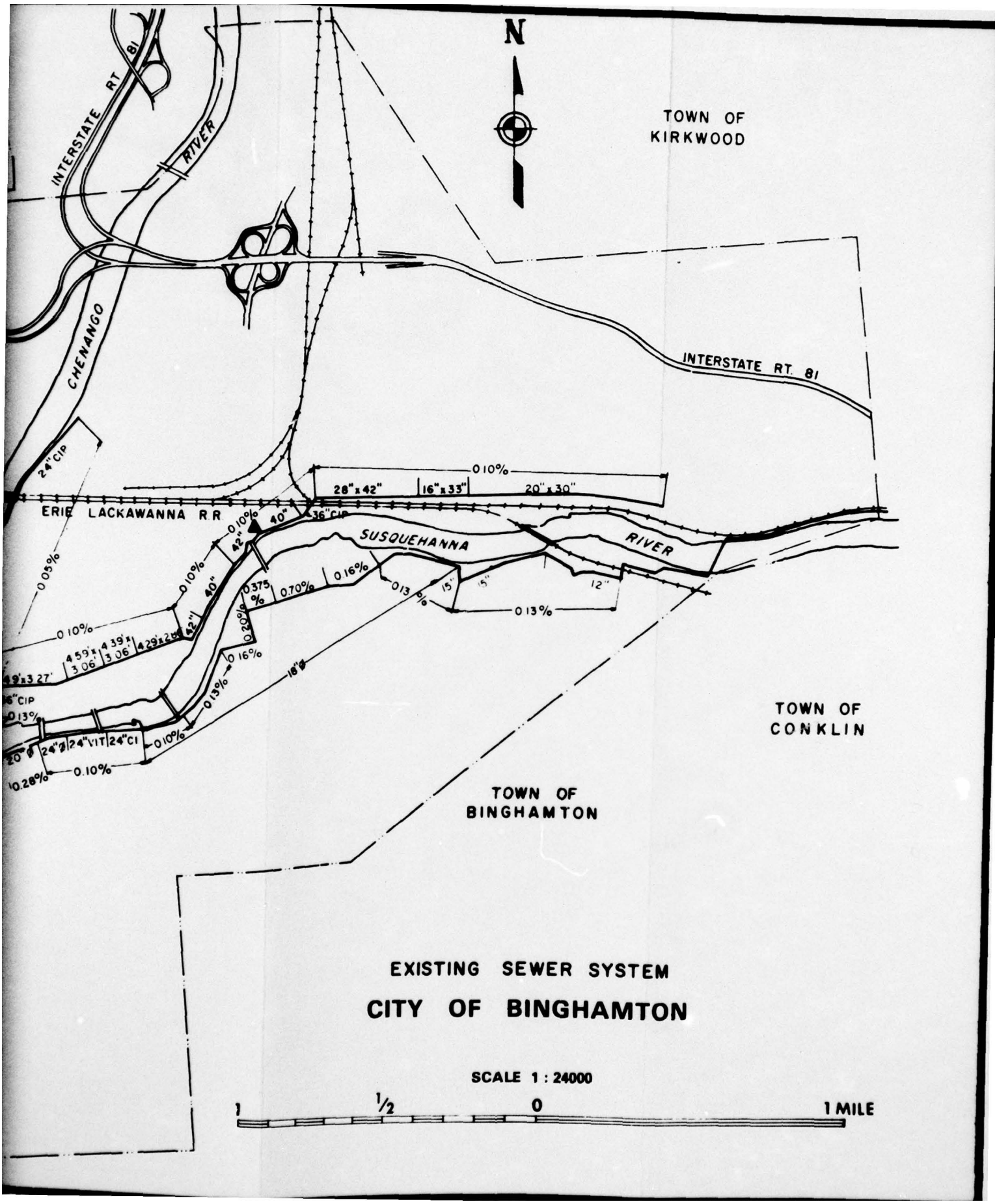
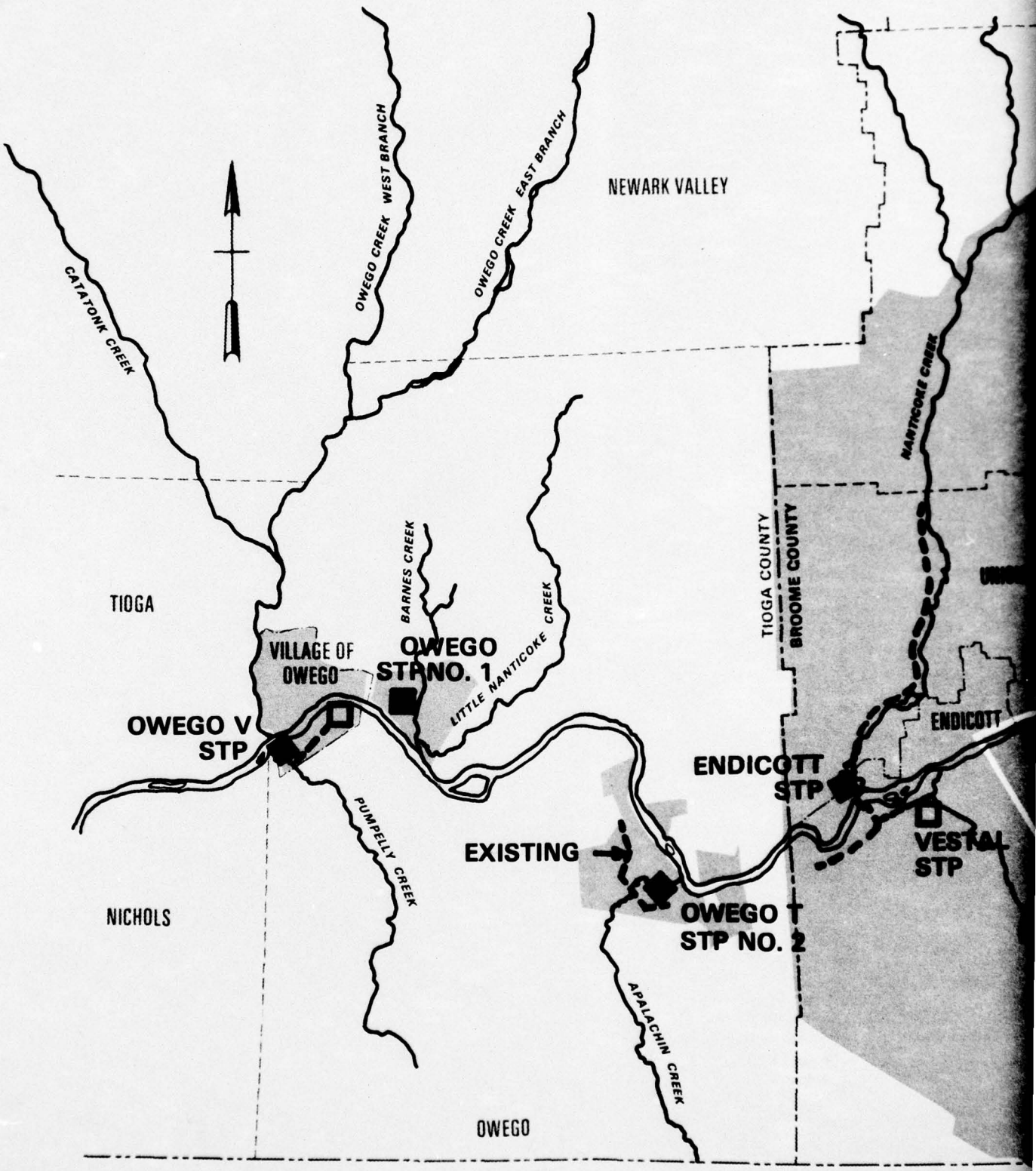

LAND APPLICATION
SITE NO. 3 3.1 MI² 4.0 MI²
CHENANGO COUNTY
BROOME COUNTY
LAND APPLICATION
SITE 7.1 NO. 1
FENTON
CHENANGO
81
CHENANGO RIVER
COLESVILLE
7
11
DICKINSON
JOHNSON CITY
CITY OF BINGHAMTON
KIRKWOOD
17
81
LAND APPLICATION
SITE NO. 2 3.1 MI²
BINGHAMTON
LITTLE SNAKE CREEK
CONKLIN
SUSQUEHANNA RIVER
Land Application Site
STP Sites
Force Main Routes
NEW YORK
PENNSYLVANIA
SCALE IN MILES
1 2 3 4 5

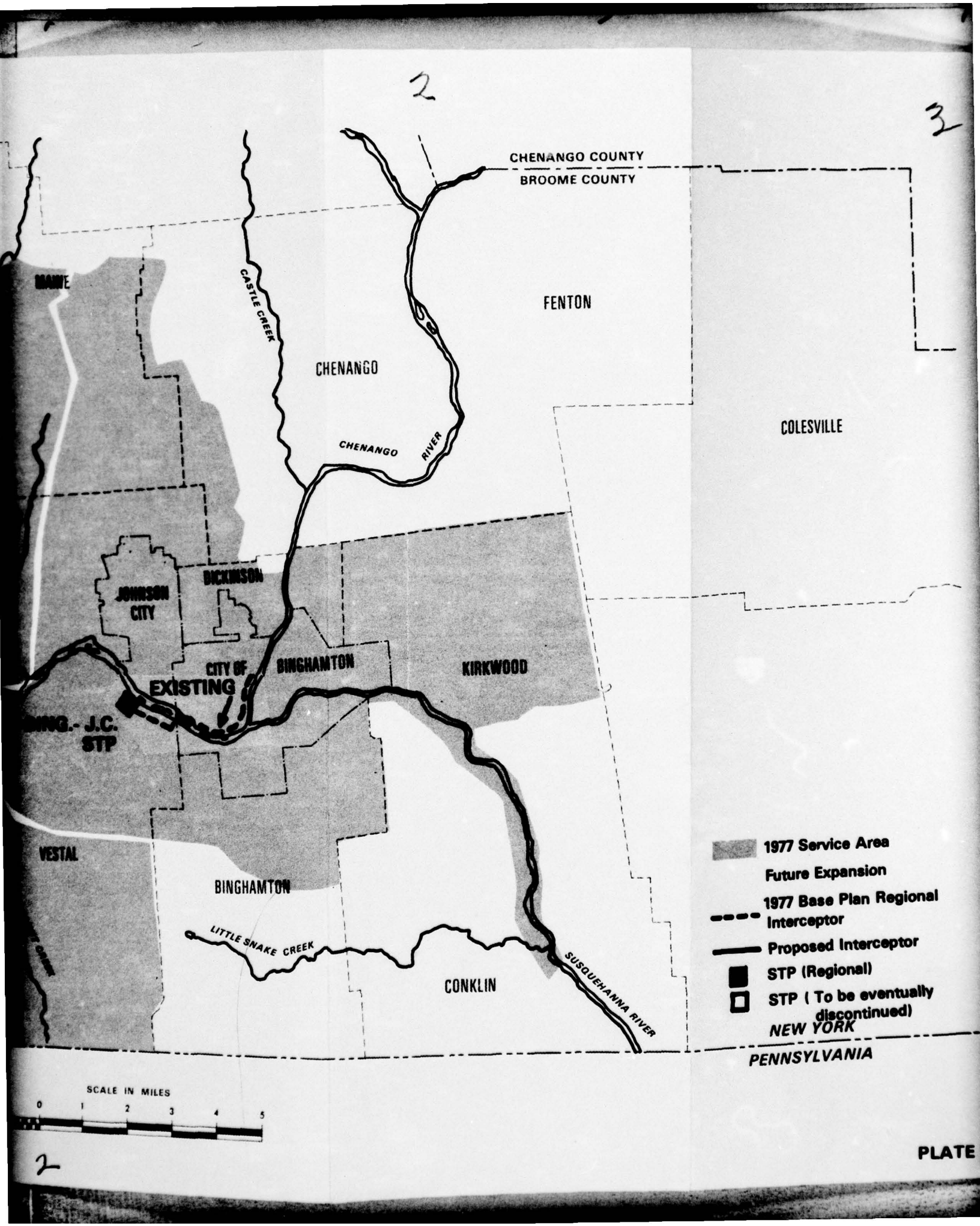
PLATE 1


TOWN OF DICKINSON
TOWN OF UNION
TOWN OF VESTAL
TOWN OF BINGHAMTON
INTERSTATE RT 81
RIVER
ROUTE 17
ERIE LACKAWANNA RR
CHENANGO
SUSQUEHANNA
RIVER
2-14"CIP
0.36%
30"RCP
3.64%
0.16%
0.13%
48"Ø
3'9"x5'7 1/4"
1.07%
4'3"x6'4 1/2"
4'x6'
4'6"x5'6"
2-30"CIP
54"RCP
42"RCP
45"RCP
36"RCP
33"RCP
24"CIP
0.10%
0.05%
36"CIP
0.13%
10.28%
0.16%
LEGEND
PUMPHOUSE
BY-PASS
45"RCP PIPE SIZE
0.10% SLOPE


N
TOWN OF KIRKWOOD
INTERSTATE RT 81
RIVER
CHENANGO
INTERSTATE RT. 81
24" CIP
ERIE LACKAWANNA R.R
0.10%
28" x 42"
16" x 33"
20" x 30"
36" CIP
40"
42"
SUSQUEHANNA
RIVER
0.05%
0.375 %
0.70%
0.16%
0.13%
15"
12"
0.20%
18"
TOWN OF CONKLIN
TOWN OF BINGHAMTON
EXISTING SEWER SYSTEM
CITY OF BINGHAMTON
SCALE 1 : 24000
1
1/2
0
1 MILE

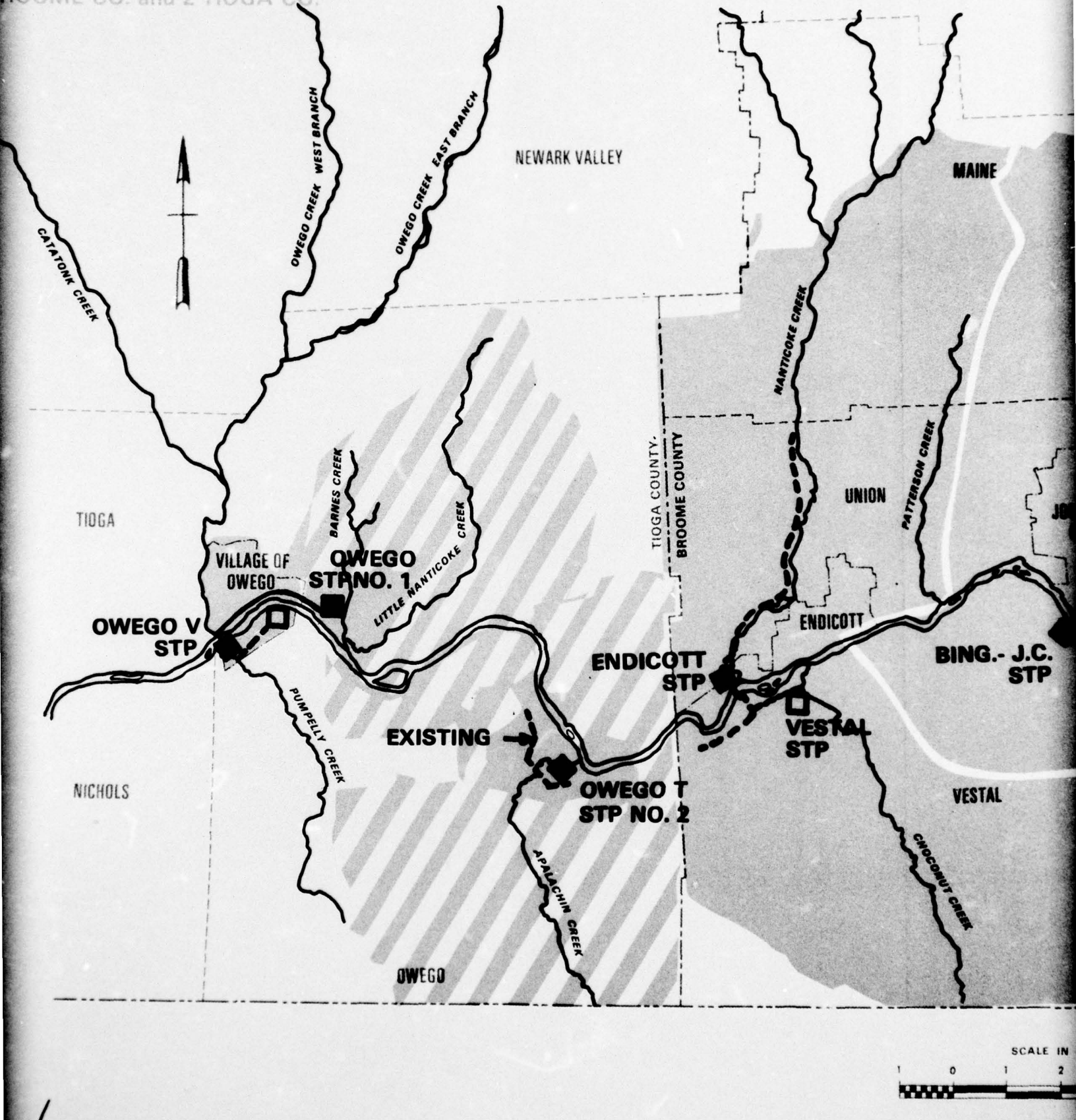
BASELINE PROFILE

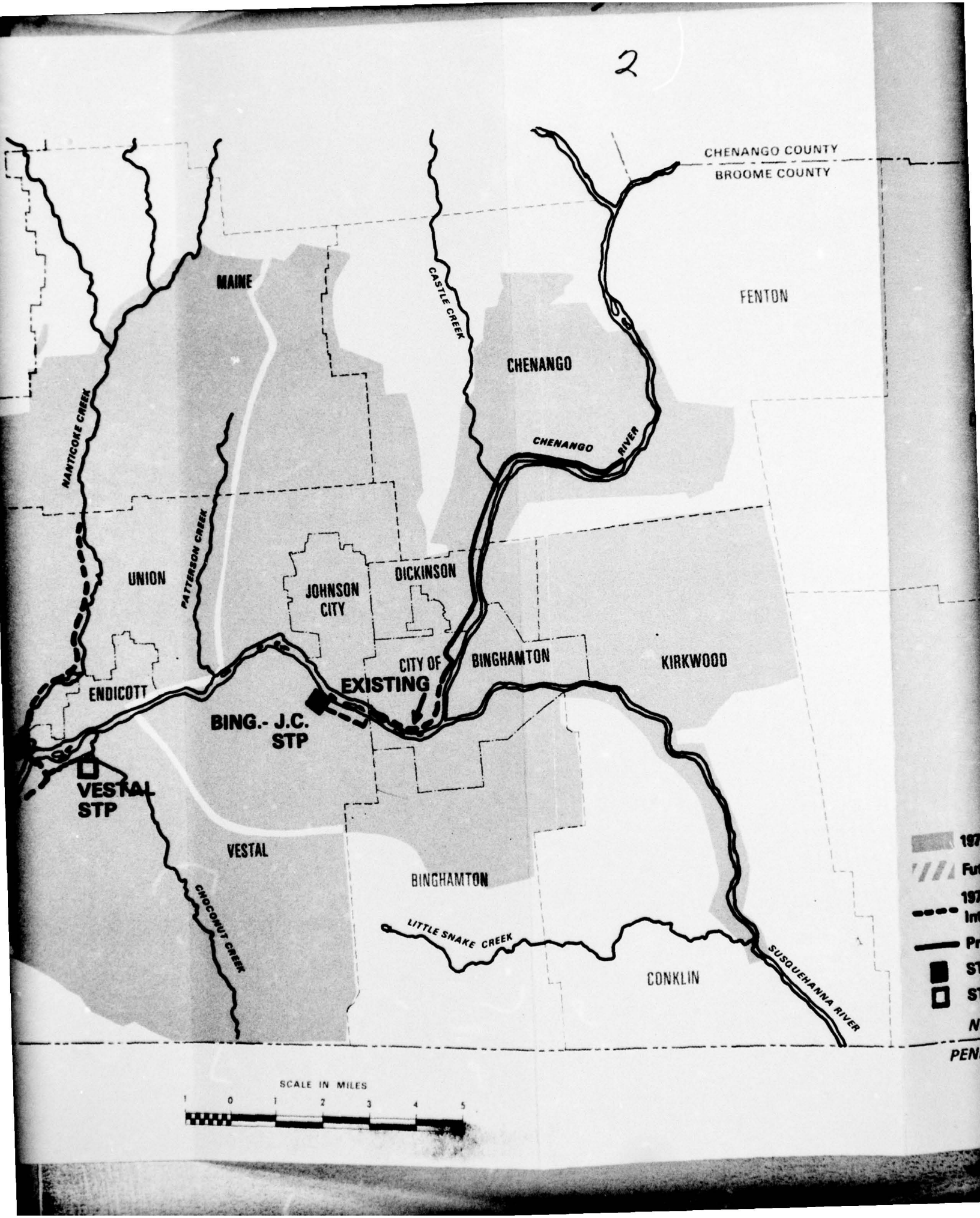



2
3
CHENANGO COUNTY
BROOME COUNTY
FENTON
CHENANGO
COLESVILLE
CASTLE CREEK
CHENANGO RIVER
JOHNSON CITY
BINGHAMTON
CITY OF BINGHAMTON
EXISTING
KIRKWOOD
VESTAL
BINGHAMTON
LITTLE SNAKE CREEK
CONKLIN
SUSQUEHANNA RIVER
NEW YORK
PENNSYLVANIA
1977 Service Area
Future Expansion
1977 Base Plan Regional Interceptor
Proposed Interceptor
STP (Regional)
STP (To be eventually discontinued)
SCALE IN MILES
0 1 2 3 4 5
2
PLATE

UR REGIONAL TREATMENT PLANTS

ROOME CO. and 2 TIOGA CO.




CHENANGO COUNTY
BROOME COUNTY
MAINE
FENTON
CASTLE CREEK
CHENANGO
CHENANGO RIVER
NANTICOKE CREEK
PATTERSON CREEK
UNION
JOHNSON CITY
DICKINSON
CITY OF BINGHAMTON
KIRKWOOD
ENDICOTT
EXISTING
BING.- J.C. STP
VESTAL STP
VESTAL
BINGHAMTON
CHOCONUT CREEK
LITTLE SNAKE CREEK
SUSQUEHANNA RIVER
CONKLIN
SCALE IN MILES
1 0 1 2 3 4 5

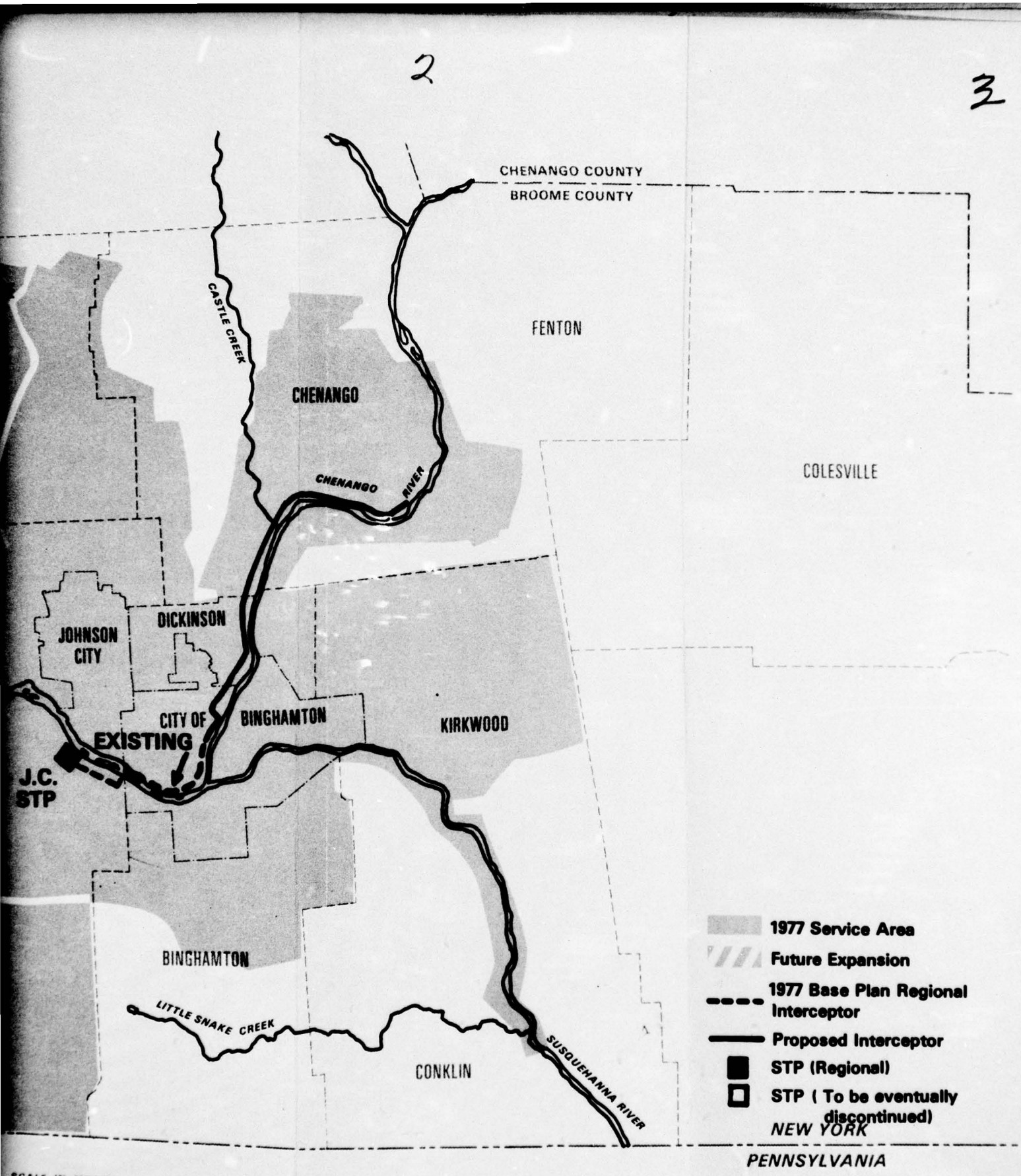
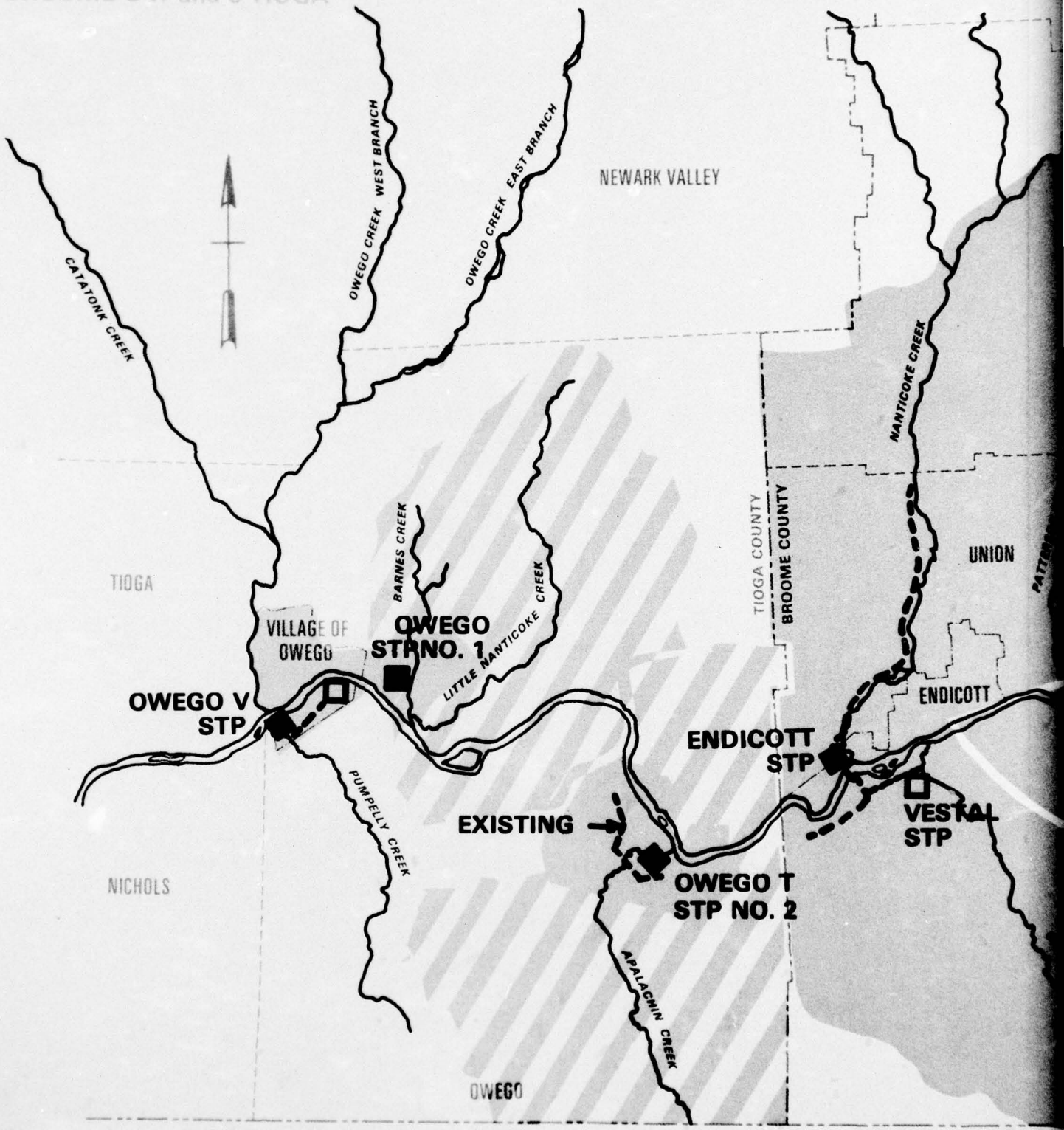
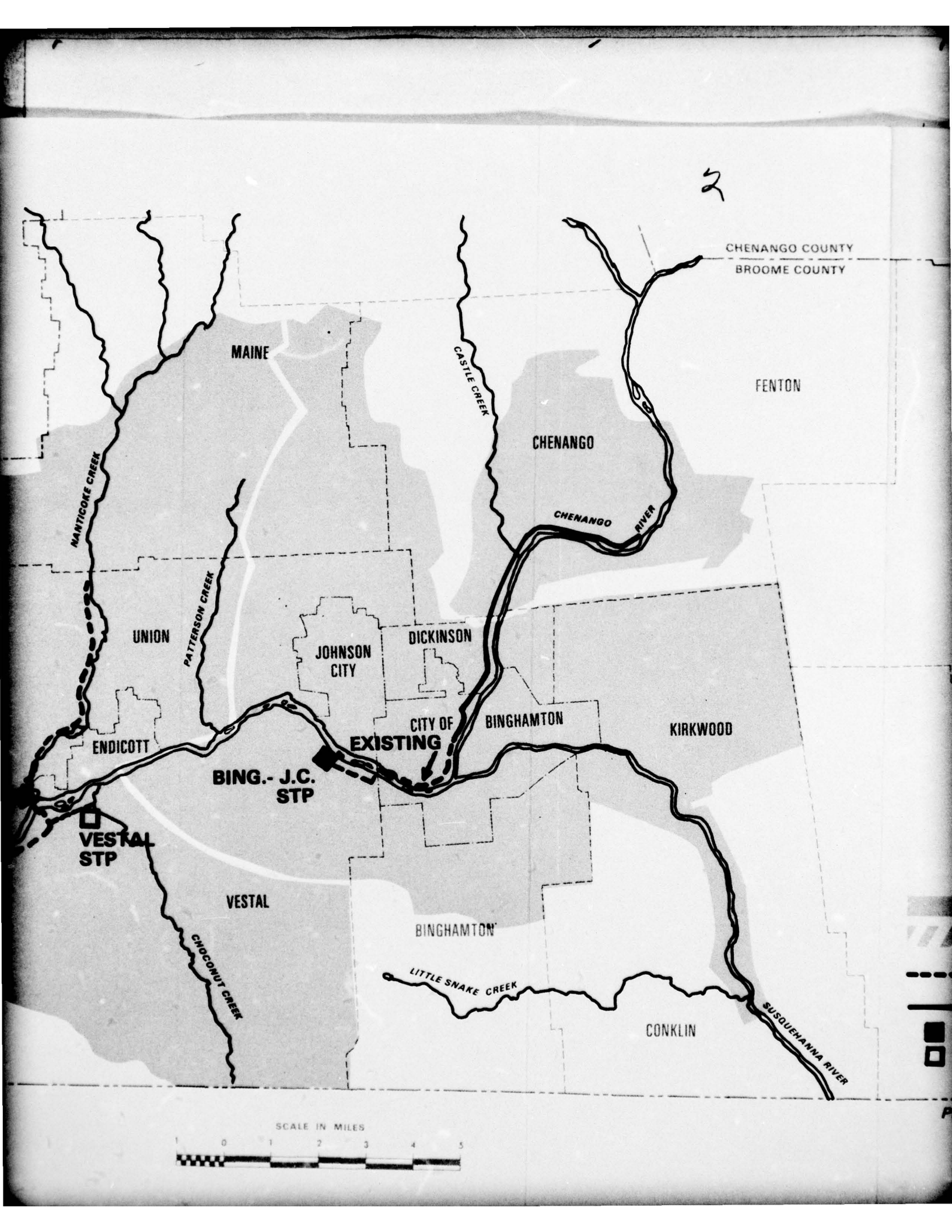

2
3
CHENANGO COUNTY
BROOME COUNTY
CASTLE CREEK
FENTON
CHENANGO
CHENANGO RIVER
COLESVILLE
JOHNSON CITY
DICKINSON
CITY OF BINGHAMTON
EXISTING
J.C. STP
KIRKWOOD
BINGHAMTON
LITTLE SNAKE CREEK
CONKLIN
SUSQUEHANNA RIVER
1977 Service Area
Future Expansion
1977 Base Plan Regional Interceptor
Proposed Interceptor
STP (Regional)
STP (To be eventually discontinued)
NEW YORK
PENNSYLVANIA
SCALE IN MILES
0 1 2 3 4 5

PLATE 4

FIVE REGIONAL TREATMENT PLANTS

2 BROOME CO. and 3 TIOGA




CHENANGO COUNTY
BROOME COUNTY
MAINE
FENTON
CASTLE CREEK
CHENANGO
NANTICOKE CREEK
CHENANGO RIVER
PATTERSON CREEK
UNION
JOHNSON CITY
DICKINSON
CITY OF BINGHAMTON
KIRKWOOD
ENDICOTT
EXISTING
BING.- J.C. STP
VESTAL STP
VESTAL
BINGHAMTON
CHOCONUT CREEK
LITTLE SNAKE CREEK
CONKLIN
SUSQUEHANNA RIVER
SCALE IN MILES
1 0 1 2 3 4 5

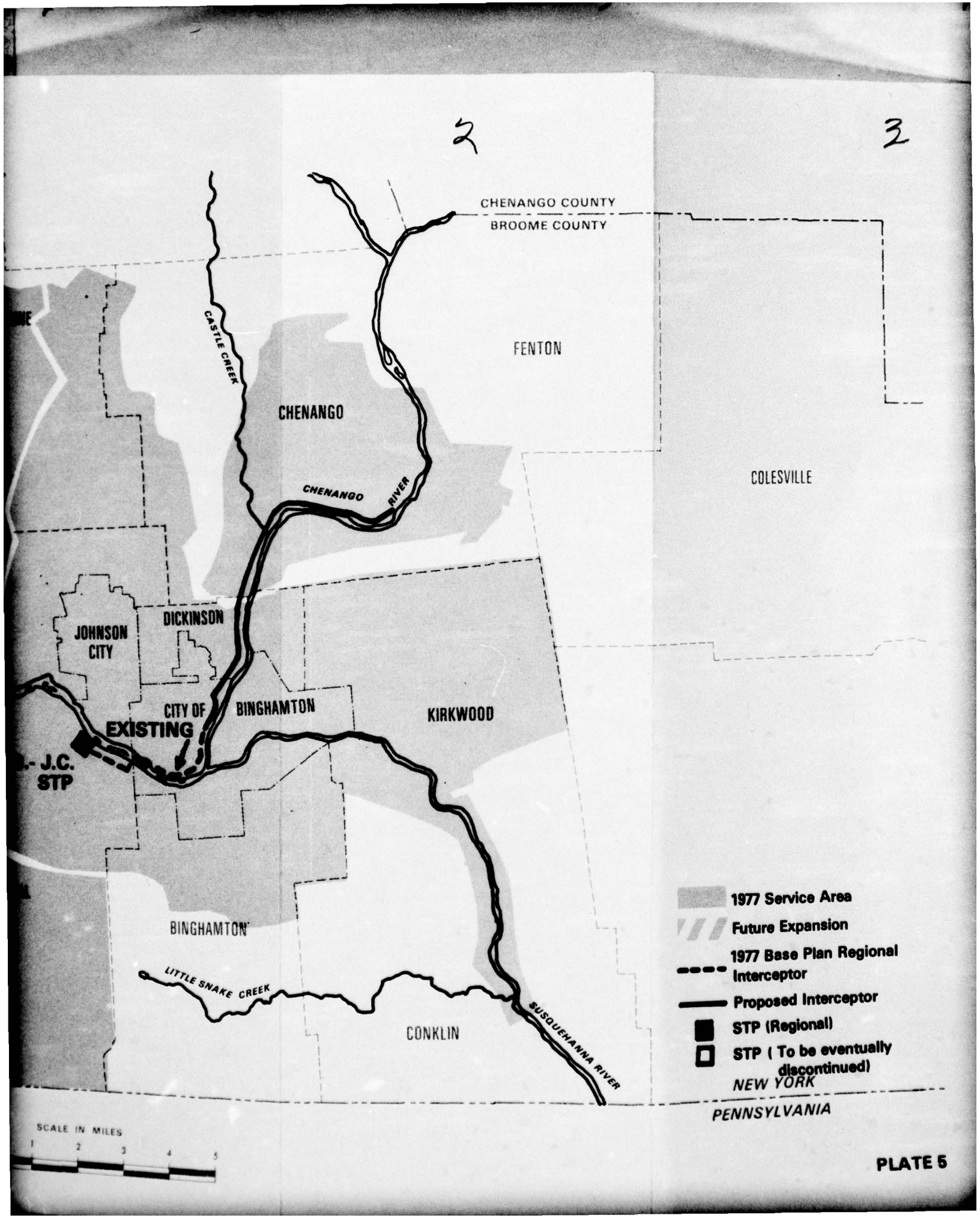
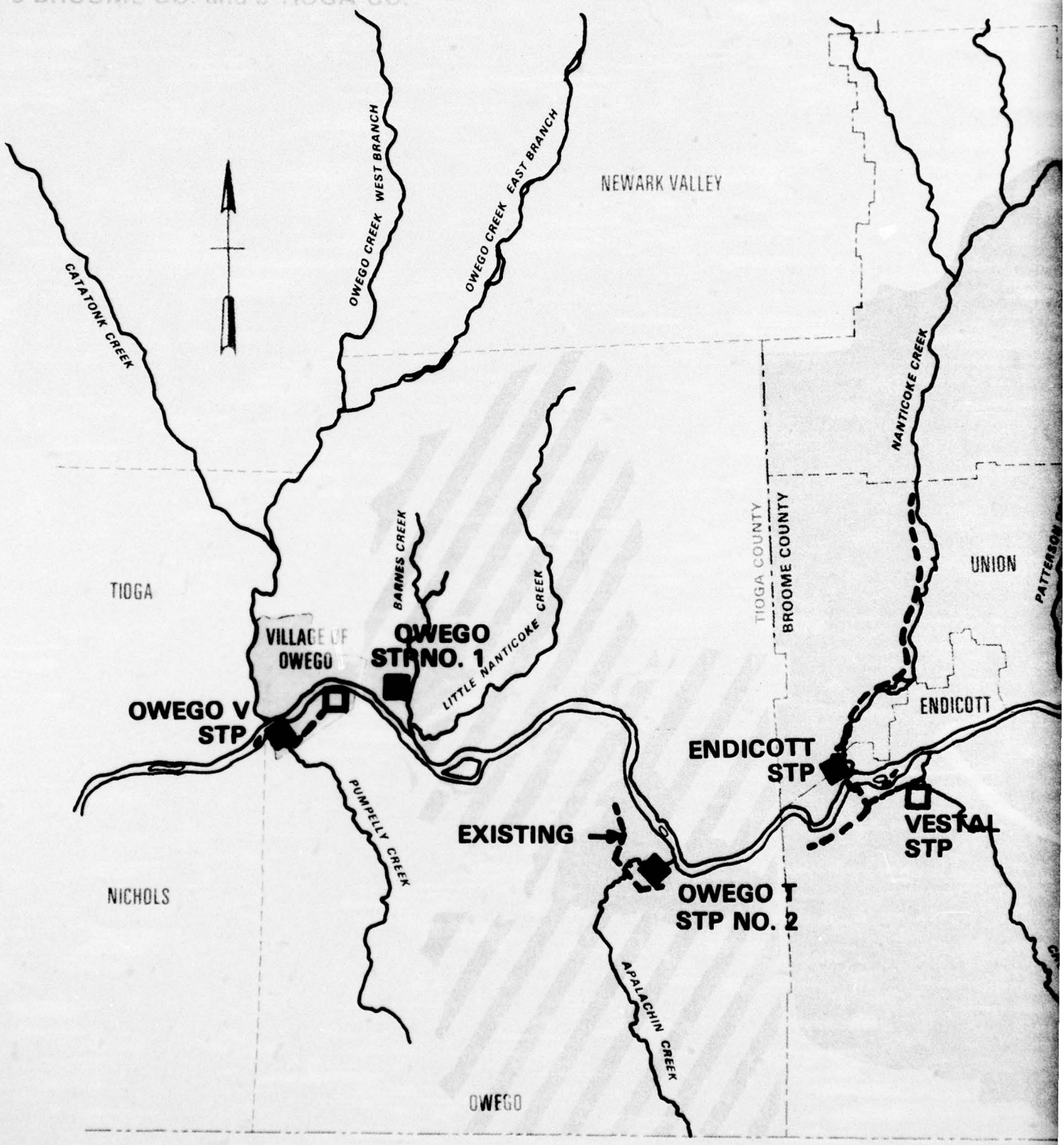
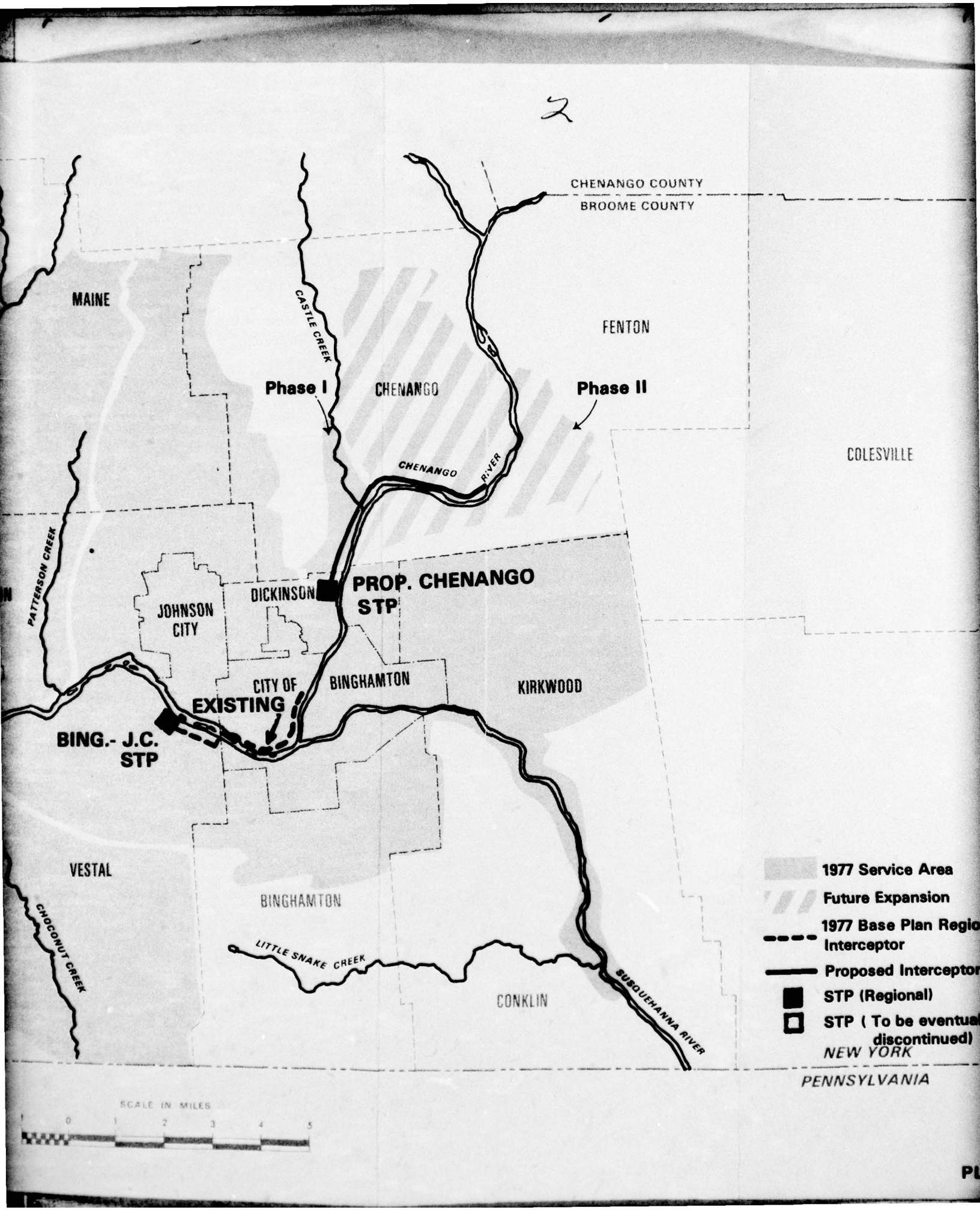

2
3
CHENANGO COUNTY
BROOME COUNTY
FENTON
COLESVILLE
CASTLE CREEK
CHENANGO
CHENANGO RIVER
JOHNSON CITY
DICKINSON
CITY OF BINGHAMTON
EXISTING
J.C. STP
KIRKWOOD
BINGHAMTON
LITTLE SNAKE CREEK
CONKLIN
SUSQUEHANNA RIVER
NEW YORK
PENNSYLVANIA
1977 Service Area
Future Expansion
1977 Base Plan Regional Interceptor
Proposed Interceptor
STP (Regional)
STP (To be eventually discontinued)
SCALE IN MILES
1 2 3 4 5

PLATE 5

SIX REGIONAL TREATMENT PLANTS

3 BROOME CO. and 3 TIOGA CO.




2
CHENANGO COUNTY
BROOME COUNTY
MAINE
CASTLE CREEK
FENTON
Phase I
CHENANGO
Phase II
COLESVILLE
CHENANGO RIVER
PATTERSON CREEK
PROP. CHENANGO STP
DICKINSON
JOHNSON CITY
CITY OF BINGHAMTON
KIRKWOOD
EXISTING
BING.- J.C. STP
VESTAL
BINGHAMTON
CHOCONUT CREEK
LITTLE SNAKE CREEK
SUSQUEHANNA RIVER
CONKLIN
1977 Service Area
Future Expansion
1977 Base Plan Regio
Interceptor
Proposed Interceptor
STP (Regional)
STP (To be eventual
discontinued)
NEW YORK
PENNSYLVANIA
SCALE IN MILES
0 1 2 3 4 5
PL

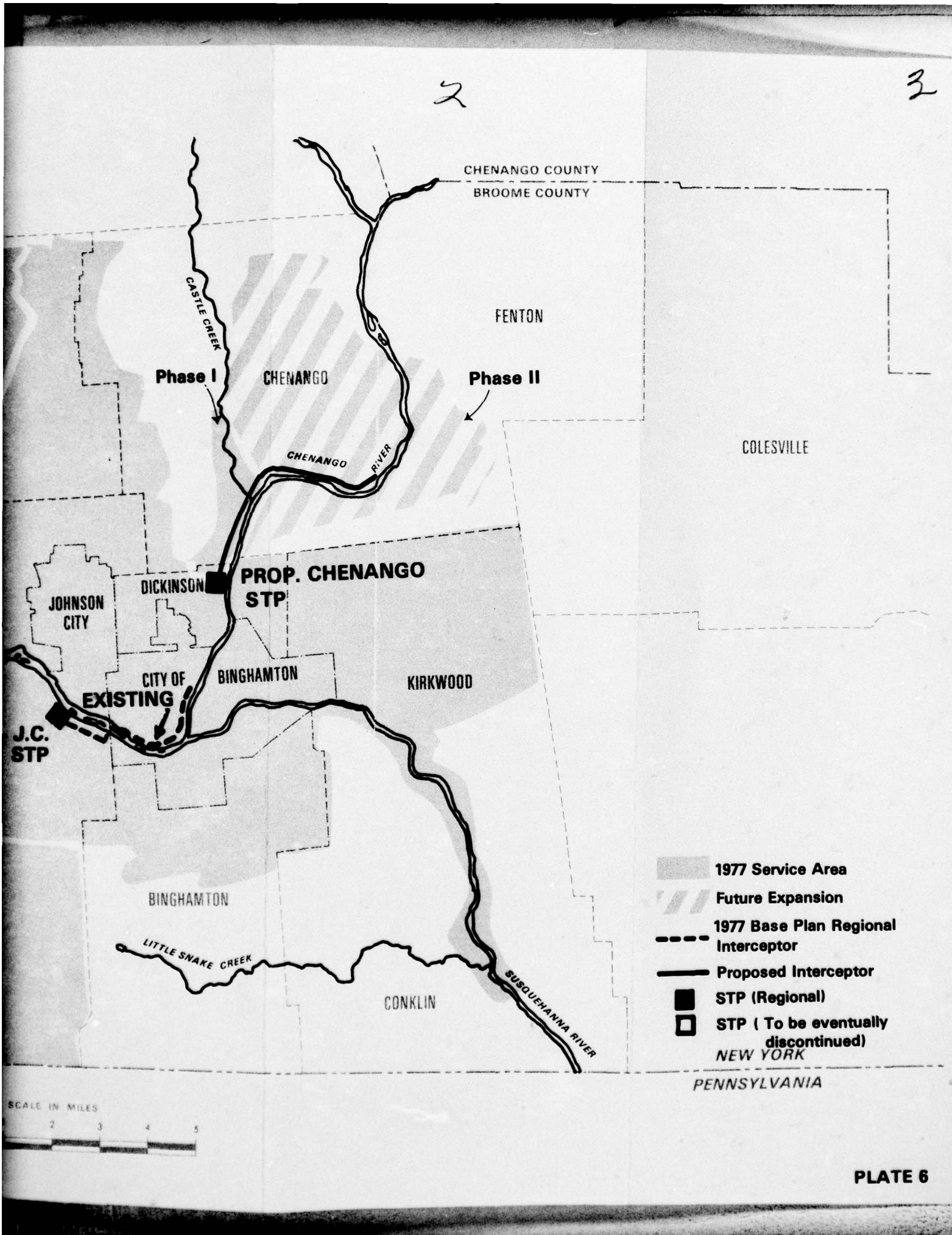

2
3
CHENANGO COUNTY
BROOME COUNTY
CASTLE CREEK
FENTON
Phase I
CHENANGO
Phase II
CHENANGO RIVER
COLESVILLE
PROP. CHENANGO STP
DICKINSON
JOHNSON CITY
CITY OF BINGHAMTON
EXISTING
KIRKWOOD
J.C. STP
BINGHAMTON
LITTLE SNAKE CREEK
CONKLIN
SUSQUEHANNA RIVER
1977 Service Area
Future Expansion
1977 Base Plan Regional Interceptor
Proposed Interceptor
STP (Regional)
STP (To be eventually discontinued)
NEW YORK
PENNSYLVANIA
SCALE IN MILES
2
3
4
5

PLATE 6